Montana's Forest Resources, 2006–2015

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Abstract

This report presents a summary of the most recent Forest Inventory and Analysis summary of Montana's forests based on field data collected between 2006 and 2015. The report includes descriptive highlights and tables of area, numbers of trees, biomass, volume, growth, and mortality, as well as an industry report. Most sections and tables are organized by forest type or forest-type group, tree species group, diameter class, or owner group. Results show that Montana's forest land covers 25.9 million acres, of which 7 million acres (27 percent) are privately owned, and 15.5 million acres (60 percent) are administered by the USDA Forest Service. The State's most abundant forest type is Douglas-fir, which covers more than 7.5 million acres. Lodgepole pine is the most abundant tree species by number of trees 5.0 inches or greater in diameter, and Douglas-fir is the most abundant by volume and biomass. Montana's forests contain 42 billion cubic feet of net volume in trees 5.0 inches diameter and larger. Montana had a negative mean annual net growth of all live trees 5.0 inches diameter at -54 million cubic feet per year over the report's evaluation period (2006–2015).

Keywords: forest inventory, FIA, Montana, resources, timber

Front cover: Glacier National Park, Montana (photo by John D. Shaw, USDA Forest Service). **Back cover:** Glacier National Park, near Saint Mary Lake, after the 2015 Reynolds Fire (photo by John D. Shaw, USDA Forest Service).

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Report Highlights

Forest Area

- Montana's forest land area totals 25.9 million acres.
- Unreserved forest land accounts for most of the forest land in Montana (85 percent) and totals 22 million acres.
- Almost 90 percent, or 19.8 million acres, of Montana's unreserved forest land is classified as timberland and the remaining 10 percent is classified as unproductive forest land.
- Privately owned forest land totals 7 million acres, or 27 percent of Montana's total forest land area.
- About 60 percent of Montana's total forest land area, or 15.5 million acres, is administered by the USDA Forest Service.
- Douglas-fir is the most abundant forest type in Montana, covering 7.5 million acres and accounting for almost 29 percent of forest land.
- Lodgepole pine covers over 4.1 million acres and is the second-most abundant forest type.

Numbers of Trees, Volume, and Biomass

- There are almost 11.7 billion live trees 1.0 inch or greater in diameter in Montana.
- Softwood species total almost 11.4 billion trees or about 97 percent of all live trees in Montana.
- Numbers of lodgepole pine trees 1.0 inch or greater in diameter total almost 2.7 billion, making this species the single most abundant tree in Montana.
- The net volume of live trees ≥5.0 inches diameter in Montana on forest land totals almost 42 billion cubic feet.
- Growing-stock volume on timberland in Montana totals 34 billion cubic feet, or 81 percent of the total live volume on forest land. Most of this volume occurs on National Forest System lands (76 percent), with 17 percent on private lands and 4 percent on State lands.
- The net volume of sawtimber trees on timberland equals 144 billion board feet.
- The above-ground weight for all live trees 1.0 inch or greater in diameter on Montana forest land is 775 million tons of oven-dry biomass.
- Commercial timber harvest in 2014 was 411.5 million board feet (Scribner), which marked a 10 percent increase from the 2009 harvest but a 48 percent decrease from 2004.
- Douglas-fir provided more (170 million board feet) of the 2014 harvest than any other species.

Forest Health

- Gross annual growth of all live trees ≥5.0 inches diameter on Montana forest land totaled 877.6 billion cubic feet. Average annual net growth totaled -54 million cubic feet, indicating a decreasing inventory in Montana.
- Average annual mortality of trees ≥5.0 inches diameter totaled about 932 million cubic feet.
 The leading causes of mortality by volume were fire (50 percent), insects (43 percent), and diseases (6 percent).
- Volume of mortality exceeded gross growth for the Lodgepole pine and Other western softwoods species groups in Montana.
- Thirty-one percent of Montana's 3.81 billion live trees (≥5.0 inches in diameter) had a damage agent recorded, the majority being from defects.
- Lodgepole pine and Douglas-fir accounted for 80 percent of all live trees damaged by insects.
- Whitebark pine trees are found outside of the Whitebark pine forest type 83 percent of the time in Montana.
- Dead whitebark pine outnumber live in diameter classes larger than 9.0 inches.
- Insects and disease are the primary mortality agents for whitebark pine, accounting for 51 percent and 25 percent of total mortality, respectively.

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Introduction

Montana encompasses a wide variety of forested environments that are valued for their scenic beauty, wood and non-timber forest products, wildlife habitat, and ecosystem services. In 2003, the Forest Inventory and Analysis (FIA) program began implementation of the new annual inventory (Gillespie 1999) in Montana. This report contains highlights of the status of Montana's forest resources based on the full cycle of forest inventory data, culminating in data collected in 2015.

This section describes how to access Montana's forest data and briefly summarizes inventory methods and previous forest inventories in this State. The following sections present an overview of traditional forest attributes measured by the FIA program, such as forest land area and tree volume; outputs of the local forest products industry; and indicators of forest health. The appendices include supplemental information, including a glossary of terms used in this report, standard forest resource tables, descriptions of Montana's forest types and forest-type groups, and a list of tree species found in Montana.

Accessing Montana's Forest Inventory Data

FIA data are publicly available from the national FIA website at https://www.fia.fs.fed.us/. This site includes data downloads; online tools that allow users to perform custom queries; documentation of FIA's field inventory protocols; database structure; sampling and estimation procedures; and other publications. Annual inventory data are updated each spring to include the most recent data available to the public. For assistance with finding information on this site or with performing custom analyses, data users are encouraged to contact one of the members of the Analysis Team of the Interior West FIA program who are listed as authors at the beginning of this report, or the contact listed under customer service on the website. Plot data may be downloaded in table form or summarized using a variety of online tools (https://www.fia.fs.fed.us/tools-data/default.asp).

In 2013, the remeasurement phase of Montana's inventory began as plots from the 2003 subpanel were remeasured. Each plot that is measured as a part of the annual inventory is assigned an inventory year, when the plot is scheduled for measurement in a 10-year remeasurement cycle (for example, 2005, 2015, 2025, etc.). Annual inventory data are updated each year to include the most recent data available to the public. Occasionally, a few plots are measured outside of their inventory year. Estimates for growth, removals, and mortality account for these different remeasurement periods.

History of Forest Inventory in Montana

Prior to implementation of the annual forest inventory, Montana's forest attributes were measured sporadically over periods of a few to several years and repeated roughly every 10 years. These are referred to as periodic inventories. The most recent periodic inventory reports for Montana were completed in 1993 (Conner and O'Brien 1993) and 1985 (Green et al. 1985). There are enough differences between periodic inventory procedures and current procedures that comparisons may produce misleading results and are not recommended (Goeking 2015). These dangers were addressed by Green et al. (1985): "Comparing

statistics from successive forest inventories is always tempting. Not particularly wise, but tempting... Changes in inventory techniques...can lead such comparisons to some rather flimsy and unfounded conclusions." Data from the 1989 inventory are similar enough in format to be housed in the FIA database and are available via the methods above, increasing the temptation for comparison. Data from the annual inventory have been used in a previous 5-year report for data collected from 2003 through 2009 (Menlove et al. 2012), which includes a detailed comparison of the two methodologies.

The annual inventory is designed with the intention of being able to compare successive reports. This report can be compared to analyses conducted for the 2012 report, while keeping in mind several definitional changes within FIA that could contribute to apparent changes. These changes have been applied to the data used in the 2012 report, so current queries and tables run from those data will differ slightly from the report, but will more accurately reflect actual changes in forest attributes from the earlier report period to the current report.

Overview of Inventory Methods

The annual forest inventory of Montana's forests follows sampling procedures that meet requirements outlined by Federal legislation and the national FIA program. In 1998, the Agriculture Research Extension and Education Reform Acts mandated that inventories would be conducted throughout the forests of the United States on an annual basis. This annual system integrates a nationally consistent plot configuration with four fixed-radius subplots, a systematic national sampling design consisting of one plot per approximately 6,000 acres (Phase 2 density), annual measurement of a consistent proportion of permanent plots, data or data summaries within 6 months after yearly sampling is completed, and a State summary report for every 5 years of data collection. The inventory strategy for the Western United States involves measurement of 10 systematic samples, or subpanels, where one subpanel is completed each year and all subpanels are measured over a 10-year period. Each subpanel is pre-assigned to be surveyed during a specific calendar year, which is referred to as inventory year (see Appendix A for standard FIA terminology). The year in which each plot was actually surveyed is recorded as its measurement year. In Montana, inventory year and measurement year are the same for the vast majority of field plots. FIA's statistical sampling and estimation procedures are described in more detail in Bechtold and Patterson (2005).

The Montana inventory began plot remeasurement in 2013, when plots first measured in 2003 were revisited. This report is based on a full cycle of forest monitoring data: Plots measured from 2006 to 2009 were included in the previous report, plots measured from 2010 to 2012 present additional data, and plots measured from 2013 to 2015 are new measurements of plots included in the previous report. The aggregated dataset includes a total of 15,854 plots, where 4,481 plots contained at least one forested condition, 10,907 plots were entirely nonforest, and 466 plots were not sampled (fig. 1). Plots can have one or more conditions found within their boundaries, and when this occurs, forest attributes are measured and summarized by each condition on the plot rather than the entire plot as a single sample. Some of the nonsampled plots may be measured in the future.

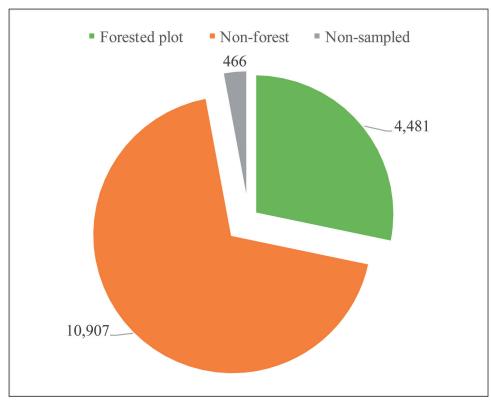


Figure 1—Number of plots in the 2006–2015 evaluation period for Montana.

Overview of Tables in This Report

Forest Inventory and Analysis produces a set of standard tables that incorporate most of the FIA program. Appendix B presents tables B1–B37, which summarize annual forest inventory data collected in Montana between 2006 and 2015 in terms of traditional FIA attributes. These tables encompass statistics for land area, number of trees, wood volume, biomass (oven-dry weight), growth, mortality, and sampling errors. Table B1 is the only table that includes all land cover types, and it summarizes the proportions of sample plots that were recorded as forest, nonforest, and nonsampled (e.g., due to inaccessibility). All other tables exclude nonforest land and therefore pertain only to accessible forest land or timberland (see Appendix A for definitions). Table B37 shows sampling errors for area, volume, net growth, and mortality at the 67 percent confidence level.

This report also contains supplemental tables within the body of the report. These supplemental tables are labeled consecutively as they appear (e.g., table 1). To avoid confusion between supplemental tables in the body of the report and the standard FIA tables found in Appendix B, standard tables will be referred to with the appendix letter followed by the table number (e.g., table B1).

Overview of Montana's Forests

This section summarizes the current status of Montana's forests in terms of traditional forest attributes such as forest area and ownership, forest type, numbers of trees, tree volume and biomass, and stand age. When applicable, these attributes will be compared with those from the previous 5-year report for Montana (Menlove et al. 2012). Some forest attributes are reported Statewide, while others are reported for specific forest land classifications. FIA uses a nationally consistent standard for defining different categories of forest land based on reserved status and productivity. These categories were originally developed for the purpose of separating forest land deemed suitable for timber production from forest land that was either not suitable or unavailable for timber harvesting activity, which includes woodland forest types. Note that these classifications do not always represent the same classification of land that may be done on individual land management units. Land managers who use other classification systems (e.g., lands suitable versus unsuitable for particular forest management actions), and want to produce FIA-based estimates of forest attributes based on their classification system, are encouraged to contact FIA customer service (https://www.fia.fs.fed.us/tools-data/customer-service/index. php).

Forest land is often divided into unreserved and reserved categories. Unreserved forest land is considered available for harvesting activity where wood volume can be removed for timber products. Reserved forest land is considered unavailable for any type of wood utilization management practice through administrative proclamation or legislation. It should be noted that a combination of physical and regulatory factors may preclude removal of timber products from unreserved forest land, and timber removal may occasionally be allowed on reserved forest land to meet non-timber management objectives.

Both unreserved and reserved forest lands can be further divided based on productivity. Unreserved forest land is subdivided into timberland and unproductive forests. Timberland is defined as unreserved forest land capable of producing 20 cubic feet per acre per year of wood from timber species. Unproductive forests, because of a combination of woodland (non-timber) tree species and site conditions, are not capable of producing 20 cubic feet per acre of commercial-quality wood (see Appendix A for definitions). Reserved forest land can also be divided into productive and unproductive forests. Some characteristics that contribute to productivity can be visibly obvious, such as the presence or absence of non-commercial species, rocky substrates, steep slopes, and high elevation. While these distinctions may be important for understanding reserved area management (e.g., their effect on visitor experience), wood production on reserved forest land is useful as a potential indicator of non-timber values, such as wildlife habitat, carbon sequestration, and preservation of old growth characteristics.

Forest Land Area and Forest Ownership

The State of Montana encompasses 94.1 million acres of land and water area, of which 25.9 million acres (28 percent) were estimated to be forest land by FIA. Unreserved forest land accounts for 85 percent of the forest land in Montana and totals 22.0 million acres (table B2). Timberland constitutes 90 percent (19.8 million acres) of Montana's unreserved forest land, and the remaining 10 percent (2.3 million acres) is classified as unproductive forest land. Reserved forests account for about 15 percent (3.8 million acres) of total forest land, with the majority (91 percent) classified as productive forests.

Montana's forests are distributed among several ownership groups that are geographically dispersed throughout the State (fig. 2). National Forests manage more forest land in Montana than any other ownership or management group (table B2), totaling 15.5 million acres, or 60 percent of the State's total forest land area. The USDA Forest Service's National Forest System (NFS) in Montana consists of 11 proclaimed National Forests, several of which are administratively combined, and cover 19 percent of the land area. Eighty-three percent, or 12.8 million acres, of the forest land managed by NFS is classified as unreserved forest land. About 95 percent of all unreserved forest land managed by NFS, or 12.1 million acres, is further classified as unreserved timberland, while the remaining 5 percent is classified as unproductive, unreserved forest land. The total net volume of live trees (table B12), as well as the average annual tree mortality (table B25), is higher on NFS lands than any other owner class.

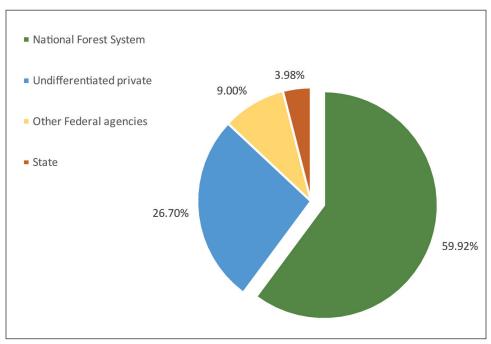


Figure 2—Percentage of forest land by ownership class, Montana 2006–2015.

Private landowners are the second-largest group of forest land managers in Montana with 6.9 million acres, or 27 percent of the State's forest land. Private forest landowners in Montana include individuals and families, corporations, Native American tribes, and non-governmental conservation organizations and partnerships. These results differ slightly from Montana's previous forest report in that no private forest land was classified as reserved by FIA. Classifying these areas as reserved risks undermining FIA owner confidentiality requirements (see *Introduction* in this report). Eighty-five percent, or 5.8 million acres, of the private forest land in Montana is further classified as timberland, with the remaining 15 percent classified as unproductive and unreserved (table B2).

Other administrators of Montana's forest land include the Bureau of Land Management with 1.4 million acres, or 5 percent; the State of Montana with 1.0 million acres, or 4 percent; the National Park Service with 0.9 million acres, or 3 percent; and the U.S. Fish and Wildlife Service with 0.2 million acres, or 1 percent. County or municipal governments and other Federal agencies each manage less than 1 percent of forest land in Montana.

Forest Types and Forest-Type Groups

Forest type is a classification of forest land based on the species forming a plurality of living trees growing in a particular forest. The distribution of forest types across the landscape is determined by factors such as climate, soil, elevation, aspect, and disturbance history. Forest types may differ with respect to diversity, structure, and successional stage. The loss or gain of a particular forest type over time can help assess the impact of major disturbances related to fire, weather, climate, insects, disease, and human-caused disturbances such as timber harvesting or ecosystem restoration.

Forest type names may be based on a single species or group of species, and forest types are aggregated into forest-type groups to simplify interpretation of large-scale forest trends. Montana's forests include 15 forest-type groups that are further classified into 27 distinct forest types, all of which are described in Appendix C. Some forest-type groups contain only one forest type, while other forest-type groups include several individual forest types. The Fir/spruce/mountain hemlock forest-type group is an example of a group with several individual forest types. In Montana, it includes the Engelmann spruce, Engelmann spruce/subalpine fir, Grand fir, Subalpine fir, Blue spruce, and Mountain hemlock forest types. The distribution of forest types, as well as individual tree species, vary across Montana's ecological provinces (Menlove et al. 2012).

Montana's most abundant forest-type group is the Douglas-fir group, which covers 7.5 million acres and accounts for 29 percent of the forest land in the State (table B3). This group contains only the Douglas-fir forest type in Montana, although other types are included in other parts of the United States. The second-most abundant forest-type group is the Fir/spruce/mountain hemlock group, which comprises 5.3 million acres, or 20 percent, of the State's forest land (fig. 3). Within this group, the Engelmann spruce/subalpine fir forest type is the most abundant with nearly 2.8 million acres, followed by the Subalpine fir forest

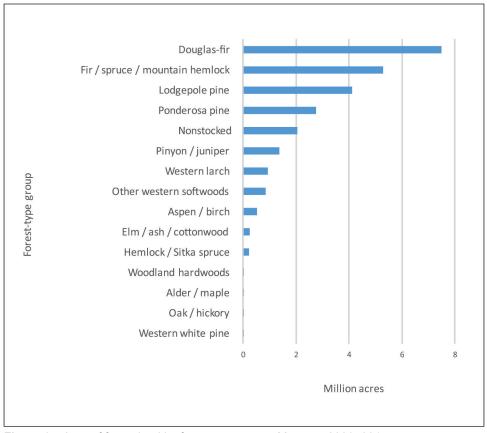


Figure 3—Area of forest land by forest-type group, Montana 2006–2015.

type at 1.5 million acres. The Lodgepole pine forest-type group (containing only the Lodgepole pine forest type) is Montana's third most abundant group, covering 4.1 million acres and 16 percent of the State's forest land. Next in order of acreage are the Ponderosa forest-type group, with only the Ponderosa pine forest type found in Montana (2.7 million acres); and the Nonstocked forest stands (2.0 million acres), which include forest land that has been harvested or highly disturbed by natural events such as fire, disease, or insect outbreak.

Number of Trees

Estimates of the numbers of trees are beneficial to a variety of silvicultural, forest health, and habitat management applications. These estimates are typically combined with information about the size and species of the trees to provide meaningful summaries of forest dynamics and stand structure. Younger forest stands usually consist of large numbers of small-diameter trees, whereas older forest stands contain small numbers of large-diameter trees. FIA classifies individual tree species into species groups and also categorizes each species and species group as either softwood or hardwood (Appendix D).

Montana contains an estimated 11.7 billion live trees 1 inch in diameter or larger (table B10) and 1.2 million dead trees 5.0 inches in diameter or larger. Softwood species total 11.4 billion trees or 97 percent of the State's live trees. Around 67 percent of live softwood trees are under 5.0 inches in diameter and a little over 2 percent are 15.0 inches and larger in diameter. The True fir species

group contains the most live trees with 2.7 billion and accounts for 24 percent of all softwood trees in Montana. Within this species group, Subalpine fir is the most abundant tree species with 2.5 billion trees, accounting for over 21 percent of the live trees in Montana. The second-most abundant softwood group is the Lodgepole pine group with just under 2.7 billion trees, all of which are lodgepole pine. Third in abundance is the Douglas-fir group with 2.6 billion trees, all of which are Douglas-fir. Figure 4 presents the estimated number of live and standing dead trees by diameter class in Montana.

Hardwood species account for 372 million trees, or 3 percent of Montana's live trees. Only four species groups make up all hardwoods in Montana. The Cottonwood and quaking aspen species group comprises the majority (77 percent) of the hardwood species, with 286 million trees. Quaking aspen trees make up the majority of hardwood trees (65 percent) and of these, 87 percent are under 5.0 inches in diameter. The second-most abundant hardwood group is the Other western hardwoods species group, which consists of 57,000 trees.

Roughly 7.9 billion, or 68 percent, of Montana's trees are less than 5.0 inches diameter at breast height (d.b.h.). A pattern of many smaller trees compared to larger ones is expected for most species, but it also illustrates the different life histories of various tree species. For example, hardwood species such as bigtooth maple and quaking aspen have a very large percentage of trees in the small-diameter classes (less than 5.0 inches diameter), as these species do not generally grow to large diameters. All hardwoods species groups in Montana have at least 75 percent of their population in the 1.0–4.9 inch diameter classes. In contrast, only the True fir (79 percent) and Western redcedar (81 percent) softwood species groups have more than 75 percent of their total numbers coming from small-diameter trees.

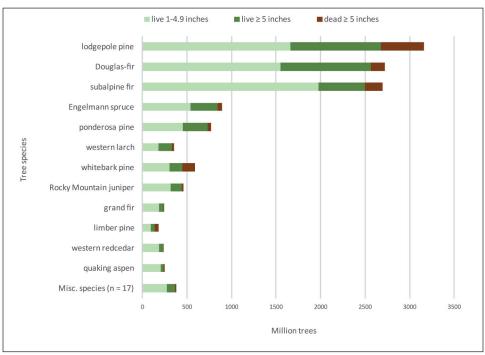


Figure 4—Number of live and standing dead trees by species and diameter class, Montana 2006–2015.

Tree Volume and Biomass

Cubic-foot volume of wood in a forest is important for determining the sustainability of current and future wood utilization. The forest products industry and forest managers are interested in knowing the tree species composition and size distribution, as well as the geographic location and ownership status, of available wood volume. Estimates of gross and net volume include only the merchantable portion or sawlog portion (e.g., cubic-foot or board-foot) of live trees. Net volume is computed by deducting rotten, missing, or form defects from gross volume. Net volume is reported below as net volume of all live trees, net volume of growing-stock trees, net volume of sawtimber, and net volume of sawlogs (Appendix A). Unless otherwise noted, all estimates of volume in this section include live trees 5.0 inches or greater in diameter. Tree biomass estimates are based on gross volumes and describe above-ground tree weight (oven-dry) by various components (merchantable bole and bark, tops and limbs, saplings). This method of estimating tree biomass is referred to as the component ratio method and is described by O'Connell et al. (2017). Note that FIA's biomass estimates are produced in units of oven-dry weight; estimates of bone-dry weight can be calculated using the following conversion: 1 bone-dry unit equals 2,400 pounds of oven-dry wood.

Tables B12 through B18 show the net volume of all live trees 5.0 inches diameter and larger on Montana's forest land, by various categories. The net volume of all live trees on Montana's forest land totals almost 42 billion cubic feet, 82 percent (34.4 billion cubic feet) of which resides in unreserved timberland (table B12). Just under 76 percent of the live volume found in unreserved timberland, or 26 billion cubic feet, is located on lands administered by the NFS. About 15 percent of the NFS-managed volume exists on reserved lands and is unavailable for harvest. Privately owned forests contain 15 percent of the State's total live volume, or 6.4 billion cubic feet. Roughly 3 percent, or 1.4 billion cubic feet, is on lands administered by State and local governments. The remainder, about 2.7 billion cubic feet, is managed by various Federal entities other than the NFS.

Live volume can also be reported by forest-type group and tree species group. With an estimated 13.1 billion cubic feet, the Douglas-fir forest-type group contains more live-tree volume than any other forest-type group in Montana (table B13). The Fir/spruce/mountain hemlock group is second in live volume at 12.5 billion cubic feet. In terms of species groups, the Douglas-fir species group (12.4 billion cubic feet) contains the most volume with Lodgepole pine species group having the second-most live volume with 8.5 billion cubic feet (table B14).

Montana has over 11.3 billion cubic feet of standing dead trees in its forests. The Lodgepole pine species group contains the highest amount of dead volume by far, with 4.6 billion cubic feet. The Douglas-fir, True fir, and Other western softwoods species groups follow with 1.7, 1.6, and 1.6 billion cubic feet, respectively.

The availability of timber volume for harvest is affected by three primary factors: reserved status, productivity, and merchantability. Timberland is defined as unreserved forest land capable of producing in excess of 20 cubic feet per acre per year of wood at culmination of mean annual increment. Merchantability refers to growing-stock trees, which are at least 5.0 inches in diameter and contain, or have the potential to produce an 8-foot sawlog that is reasonably free of defects. Therefore, growing-stock volume on timberland represents the amount of timber that is potentially available for harvest. The net volume of growing-stock trees on timberland in Montana totals just over 34 billion cubic feet (table B17), or 82 percent of the total live volume on forest land.

The distribution of growing-stock volume varies by species or species group and also by owner class (table B18). Across all owner classes, almost half of the State's growing-stock volume is composed of two species: Douglas-fir and lodgepole pine. Douglas-fir constitutes 33 percent of Montana's growing-stock volume, or 11.3 billion cubic feet, and lodgepole pine contains 20 percent, or 6.7 billion cubic. NFS lands include 31 billion cubic feet, or 75 percent of the State's growing stock. Privately owned lands contain the second-most growing-stock volume with over 6 billion cubic feet, or 15 percent of the total growing stock on Montana timberland. State and locally managed lands contain 1.4 billion cubic feet of growing stock, or 3 percent of the State's total. Live volume is also reported for sawtimber trees, which are defined as softwood trees 9.0 inches in diameter or larger, or hardwood trees 11.0 inches in diameter or larger (International ¼-inch rule). The net volume of sawtimber trees on timberland totals 143.5 billion board feet (table B19).

The total weight of oven-dry above-ground biomass on Montana's forest land is 775 million tons, of which 56 percent (437 million tons) exists in three species groups: the Douglas-fir (259 million tons), Engelmann and other spruces (90 million tons), and True fir (88 million tons) species groups (table B30). Although biomass is typically sold by green weight, the water content of wood is highly variable geographically, seasonally, and even across portions of a single tree. Therefore, care should be taken when evaluating live-tree inventory estimates of green biomass. In contrast, oven-dry weight does not change due to fluctuations in tree water content.

Volume and biomass can also be expressed in terms of the amount per acre. Table 1 shows live-tree volume (in cubic feet per acre) and biomass (in tons per acre) by forest type. The estimates for each forest type include all of the different species that occur within that forest type. Because estimates for forest types with small samples may not be representative, only forest types sampled on at least 20 plots are included in this discussion. Western redcedar has the highest per-acre net volume of live trees 5.0 inches diameter and larger, with 4,412 cubic feet per acre, and also has the highest biomass of live trees 1.0 inch diameter and larger with 73 dry tons per acre. Not surprisingly, the five forest types with the largest net volumes and biomasses are all timber types. The woodland forest type with the highest per-acre net volume and biomass is the Rocky Mountain juniper forest type, with 359 cubic feet per acre and 7 dry tons per acre.

Table 1—Estimates for net volume of live trees at least 5.0 inches in diameter per acre and aboveground dry weight of live trees at least 1.0 inch in diameter per acre, by forest type, Montana 2006–2015. Only those forest types recorded on ≥20 plots are shown.

Forest type	Cubic foot live volume per acre	Short tons live biomass per acre
Western redcedar	4,412	73
Engelmann spruce / subalpine fir	2,870	47
Grand fir	2,727	49
Western larch	2,550	50
Engelmann spruce	2,323	37
Lodgepole pine	1,849	34
Douglas-fir	1,755	36
Cottonwood	1,453	25
Whitebark pine	1,415	27
Subalpine fir	1,414	24
Ponderosa pine	1,012	19
Limber pine	399	8
Aspen	385	9
Rocky Mountain juniper	359	7
Nonstocked	59	1

Stand-Age Class

The age structure of forest land provides insight into prospective shifts in stand structure and composition over time. On every FIA plot that samples forest land and includes suitable trees for increment core extraction, stand age is estimated based on the average age of only those trees that fall within the calculated stand-size category. For example, suppose an FIA plot sampled a softwood forest type where about 30 percent of the live trees were in the large-diameter stand-size class (trees at least 9.0 inches d.b.h. and larger) and 70 percent were in the medium diameter size class (trees between 5.0 and 9.0 inches d.b.h.). The stand would be classified as a medium diameter stand-size class, and therefore only the medium-size trees would be used in determining stand age.

There are limitations to collecting data for stand-age computation. Reliable measurements of increment cores are difficult to collect from certain tree species, particularly woodland species or those that may be very long-lived. Stand age may not accurately depict the age structure of uneven-aged stands, which encompass multiple age classes. Stand ages are difficult to accurately determine for stands that are predominated by small-diameter tree species such as Gambel oak trees. Stand ages are not assigned to nonstocked conditions, which are stands that contain less than 10 percent stocking of live trees because of disturbance.

Table B6 shows the area of forest land, by age class and forest-type, with 20-year intervals representing stand-age classes. Almost half (47 percent) of Montana's forest land, or 12.1 million acres, is between 60 and 140 years of age. Stands between 80 and 100 years of age represent the largest single 20-year age class and comprise 3.9 million acres, or 15 percent of Montana's forest land area. Forests younger than 20 years cover 5.8 million acres, while forests older than 200 years cover 1.4 million acres.

Most of the major forest types in the State are either young or moderately aged, although the Douglas-fir and the Fir/spruce/mountain hemlock groups have notable acreage in the oldest classes (table B6). These two groups also show the most even distribution across all age classes. The Douglas-fir and lodgepole pine groups have a large number of acres in the young classes due to recent mortality events (see the Forest Growth and Mortality section for more details). The 201+ age class is dominated by the Fir/spruce/mountain hemlock and Douglas-fir groups, which account for 70 percent of the acreage found therein. Compared to these coniferous forest types, quaking aspen forests have a much higher percentage of its acreage that is younger than 20 years (60 percent). Conversely, only 5 percent of quaking aspen forest area is older than 100 years.

Understory Vegetation

The structure and composition of understory vegetation reflects the overall diversity, productivity, and habitat quality of forested ecosystems. FIA collects understory vegetation data using two distinct protocols that characterize overall vegetation structure and composition. Under the vegetation structure protocol, FIA field crews record the height class and percent cover that is occupied by each of four plant growth habits: forbs, graminoids, shrubs, and understory trees (trees less than 5.0 inches in diameter). Under the species composition protocol, height class, growth habit, and percent cover are recorded for individual plant species that occupy at least 3 percent of the ground area. Data collected prior to 2013 used 5 percent minimum cover for a species to be recorded. If more than four species exceed the cover threshold, then only the most abundant four species per life form are recorded. Note that the vegetation structure protocol also includes all species that have less than the minimum thresholds for being recorded under the species composition protocol. On plots where many species are present but where each species occupies less area than the cover threshold for individual species, then there are no species recorded under the species composition protocol. However, cover of these species in aggregate (and within the same growth habit) will be recorded using the understory structure protocol.

Figure 5 depicts the average percent cover of each plant growth habit within each of Montana's 10 most abundant forest-type groups. Average cover of each life form was calculated for each plot, then averaged across plots within each forest type. Understory trees cover more area than the other three growth habits in all forest types except for Ponderosa pine, Elm/ash/cottonwood, and Nonstocked forest-type groups, which all have higher average graminoid cover. Average understory tree cover ranges from 6 percent in Nonstocked forest areas to 35 percent in the Western larch forest-type. After understory tree cover, shrubs are the plant growth habit with the highest average cover in most forest-type groups. Exceptions to this pattern are the Pinyon/juniper group, which has higher

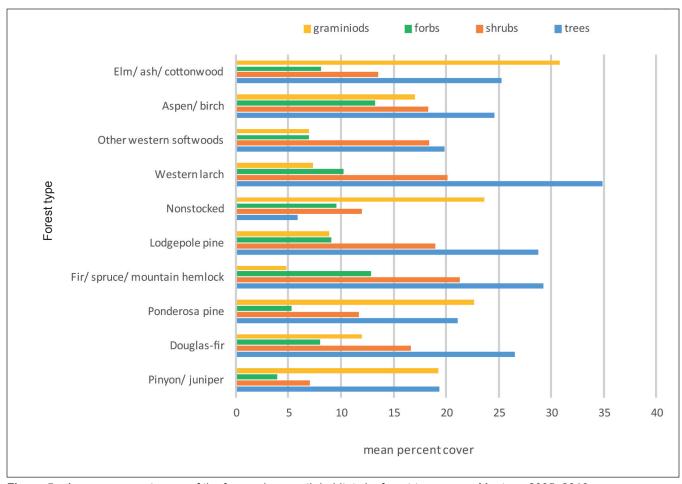


Figure 5—Average percent cover of the four major growth habitats by forest-type group, Montana 2005–2016.

mean cover of graminoids than shrubs, along with Ponderosa pine and Elm/ash/cottonwood groups that have higher mean tree cover than shrub cover. The Pinyon/juniper group has the lowest average forb and shrub cover of any forest-type group in Montana, while the Fir/spruce/mountain hemlock group has the lowest graminoid cover, and Nonstocked stands have the lowest tree cover.

A total of 789 individual plant species were identified and recorded on Montana's forest inventory plots. The four most frequently recorded species within each growth habit are listed in table 2. Common snowberry (*Symphoricarpos albus*) was the most frequently recorded species, occurring in 2,084 of Montana's forested plots, most frequently in the Douglas-fir forest type. The Douglas-fir forest type was the most frequent location for half of the species in table 2. This is unsurprising as Douglas-fir has a large ecological amplitude and is the most abundant forest type in Montana. Species diversity is highest in the forbs, with 418 species identified. Graminoid diversity is next highest with 199 species identified in Montana's forests, followed by 176 shrub species and 59 tree species. While understory tree diversity was lower than that of other growth habits, the two most ubiquitous understory tree species in table 2 were encountered much more frequently than all but two non-tree species. So while overall forb and graminoid species diversity was relatively high, no single forb or graminoid species was as common as Douglas-fir (Pseudotsuga menziesii), the most common understory tree species.

Table 2—The four most commonly encountered understory plant species in each growth habit, and what forest type they most frequently occur, Montana 2005-2016.

Growth habit	Species name	Common name	Number of plots	Average cover	Most frequent forest type where found
Trees	Pseudotsuga menziesii	Douglas-fir	1464	12.2	Douglas-fir
	Abies lasiocarpa	subalpine fir	1192	14.4	Engelmann spruce/ subalpine fir
	Pinus contorta	lodgepole pine	775	16.0	Lodgepole pine
	Picea engelmannii	Engelmann spruce	648	8.6	Engelmann spruce/ subalpine fir
Shrubs	Symphoricarpos albus	common snowberry	2084	11.5	Douglas-fir
	Vaccinium scoparium	grouse whortleberry	996	18.5	Lodgepole pine
	Spiraea betulifolia	white spirea	898	7.2	Douglas-fir
	Vaccinium membranaceum	thinleaf huckleberry	880	14.1	Lodgepole pine
Forbs	Xerophyllum tenax	common beargrass	862	13.8	Lodgepole pine
	Arnica cordifolia	heartleaf arnica	671	8.3	Douglas-fir
	Thalictrum occidentale	western meadow-rue	341	6.3	Douglas-fir
	Arnica latifolia	broadleaf arnica	286	10.6	Engelmann spruce/ subalpine fir
Graminoids	Calamagrostis rubescens	pinegrass	1312	13.4	Douglas-fir
	Pseudoroegneria spicata	bluebunch wheatgrass	706	10.9	Ponderosa pine
	Carex geyeri	Geyer's sedge	660	9.2	Douglas-fir
	Festuca idahoensis	Idaho fescue	478	10.8	Douglas-fir

Montana Timber Products Industry

In Montana, estimation of harvest quantities is currently based on surveys conducted by the University of Montana Bureau of Business and Economic Research (BBER) in cooperation with the Forest Inventory and Analysis program. Two reports, based on BBER data collection and analysis of Montana forest industry, output, and products were completed recently and are in the last stages of publication (Berg et al. 2018; Hayes et al., in press b.). This section presents highlights of selected sections from both reports; for additional details, readers can consult the original reports. As more annual inventory plots are remeasured in the State, some estimates related to timber removals and utilization will be based on FIA plot remeasurement data, and other estimates will continue to be based on BBER surveys.

Montana's Timber Harvest

Timber harvest in Montana totaled 411.5 MMBF Scribner during 2014 (MMBF = million board feet). This marked a 10 percent increase compared to the 2009 harvest of 373.5 MMBF (McIver et al. 2013) and a 48 percent decrease from the 2004 harvest of 785 MMBF (Spoelma et al. 2008). These changes can be explained in part by economic influences affecting wood products markets.

The Great Recession and a drop in U.S. home construction between 2007 and 2009 reduced the demand for lumber through 2010 and 2011 (Keegan et al. 2012). However, prior to this recession, Montana's forest products industry had already been in a long period of decline, following its peak of production in the mid-1980s. The post-recession recovery of production, and therefore harvest, represents a return to less than half of the late 1980s-early 1990s decade, and only about half of the level of the early 2000s. Declines in capacity and utilization, which started in the late 1980s, have been attributed in part to decreases in the volume of timber offered from Federal lands (Keegan et al. 2006).

Montana's timber harvest is concentrated in three general timber product categories: saw/veneer logs (timber used to produce lumber, other sawn products, and logs used to manufacture plywood), house logs (used to manufacture log homes and other associated goods), and other products (timber chipped for pulpwood, used to produce post and poles, log furniture, and industrial fuelwood). Saw/veneer logs have consistently been the leading timber product harvested in the State. In 2014 they accounted for 88.6 percent (365 MMBF) of the total timber harvest. Other products made up 10.9 percent (45 MMBF) and house logs accounted for the remaining 0.5 percent (1.7 MMBF). House logs have continued to decline, falling from their 1993 peak of 16 MMBF to 1.7 MMBF in 2014. Private lands provided over 265 MMBF (65 percent) of the 2014 harvest. National Forests provided 83 MMBF (20 percent) and the remaining 15 percent came from State (58 MMBF) and other public (4 MMBF) lands.

Harvest by Geographic Source and Species

The Northwest and Eastern regions of Montana (fig. 6) experienced an increase in harvest while the other three regions showed declines between 2009 and 2014. However, the 2014 volume harvested from the Northwest region was

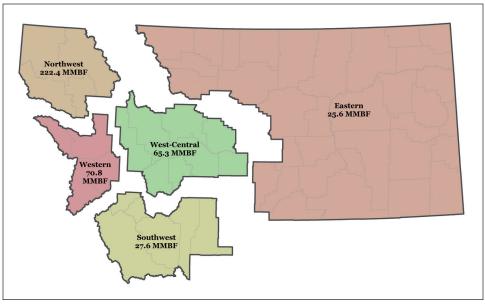


Figure 6—Montana timber harvest changes by resource area, 2009–2014 (source: McIver et al. 2013).

just 35 percent of what it was in 1981 (Keegan et al. 1983). The Western region's harvest volume has also seen a steady decline since 1981, although its proportion of the Statewide harvest has remained relatively stable, around 20 percent.

At almost 170 MMBF Scribner, Douglas-fir was the leading species harvested in Montana during 2014. Historically, Montana's timber harvest has been led by Douglas-fir, accounting for 27 to 41 percent annually. However, in 2009, lodgepole pine accounted for 35 percent, coinciding with an outbreak of mountain pine beetles that caused heavy mortality in the pine species. Between 2009 and 2014 the harvest of ponderosa pine increased from 56.6 MMBF to 64.5 MMBF, while the harvest of lodgepole pine returned to its historic average proportion of about 25 percent.

Montana's Forest Products Industry and Timber Flow

During 2014, Montana's primary forest products industry consisted of 102 active facilities. A majority of those facilities were located near forest resources in the Northwestern and Western portions of the State (fig. 7). These plants produced an array of products, including lumber and other sawn products, plywood, particleboard and fiberboard, house logs, posts, poles and rails,

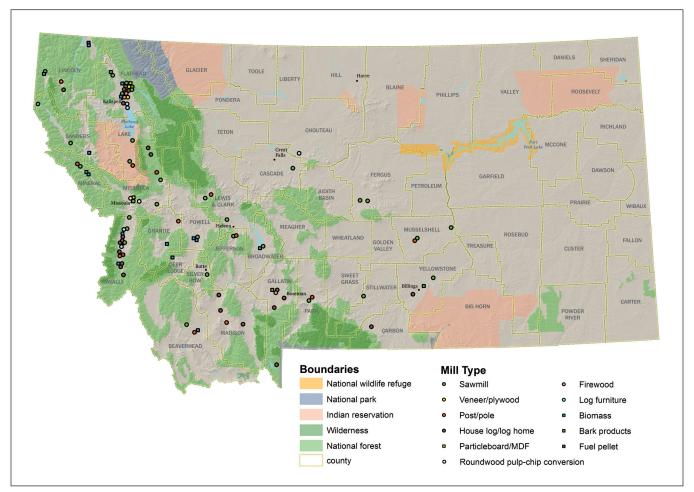


Figure 7—Montana's primary forest products manufacturers, 2014.

firewood, log furniture, and fuel pellets. Total sales of finished products exceeded 604 million dollars in 2014, a 6 percent decrease (inflation-adjusted) from 2009.

There were 25 fewer facilities than the total number reported in the 2009 census (McIver et al. 2013). The sawmill sector, manufacturing lumber and related products, still had the largest number of facilities operating during 2014. Nearly all sectors experienced a decrease of active facilities. The log home sector, manufacturing log homes and house logs, experienced the sharpest decline both in number and percent, losing eight facilities or 24 percent since 2009.

During 2014, the majority (96.6 percent) of Montana's timber harvest was processed in-State. Montana mills brought in 39.8 MMBF Scribner of timber from other States while 14.7 MMBF of Montana timber was processed out-of-State, giving the State a net inflow of 25 MMBF of timber. Sawlogs accounted for all of the timber shipped to other States for processing, as well as the majority (36.2 MMBF) of timber brought into the State. Of the 14.7 MMBF processed out-of-state, 94 percent went to Idaho mills and the remaining 6 percent was equally split between Wyoming and South Dakota mills.

Wood products manufactured within the State of Montana were largely sold to other regions. Approximately 521 million dollars (86 percent) of Montana's primary wood products sales occurred outside the State, while only about 84 million dollars (14 percent) of primary product sales stayed in-State. Lumber, plywood, and other sawn products accounted for the majority (55 million dollars) of in-State sales. The leading geographic markets reported for Montana's primary wood products were the North Central region (31 percent) followed by the Far West (17 percent each) and then the South (15 percent), with Montana and the Rockies accounting for just under 14 percent each (fig. 8). Mills distributed their products through their own distribution channels or through independent wholesalers and selling agents. Because of subsequent wholesaling transactions,

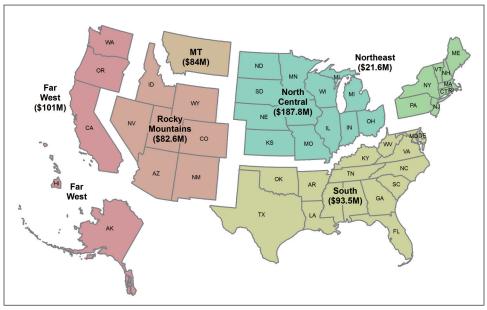


Figure 8—Destination and sales value of Montana's primary wood products, 2014.

the geographic destination reported here may not precisely reflect final delivery points of shipments.

Forestry and logging employment grew by 5 percent, while secondary manufacturing saw the smallest growth at 3 percent. Paper manufacturing experienced the most dramatic change, declining during the same 4-year period by 85 percent. Overall, employment across the forest industry has increased by 7 percent since 2010. While paper manufacturing has experienced the most severe decline over the last decade, all employment sectors (with the exception of forestry support activities) have decreased since 2005. Employment in primary wood products manufacturing fell by approximately 42 percent between 2005 and 2014 as a result of the Great Recession and weak demand for wood products causing mill closures and curtailments. The forestry and logging sector saw a 37 percent decline, and secondary manufacturing was down 33 percent over the same period.

Forest Health in Montana

Forest Growth and Mortality

To monitor changes in tree volume over time, the relationships between growth, mortality, and removals can be quantified. Growth is typically expressed as average annual net growth, and mortality defined as the average annual net volume of trees dying over a given time period due to natural causes, and excludes the volume removed through harvesting. Tree mortality normally occurs at low, "background" rates due to insects and disease, competition, or advanced tree age. Occasionally, highly concentrated and relatively localized mortality occurs due to insect and disease epidemics, wildfire, or severe weather events. Removals represent the net volume of growing-stock trees removed from the inventory by harvesting or other cultural operations (such as timber-stand improvement), by land clearing, or by changes in land use (such as an administrative change to Wilderness).

Ideally, growth, mortality, and removals would be analyzed using measurements of the same plot at two points in time. It is also possible to estimate growth and mortality rates based on a single inventory, as is described below. In contrast, removals cannot be reliably estimated without having two measurements of the same set of plots. Because of these differences in estimation procedures, growth and mortality are analyzed and discussed separately from removals (see the *Montana's Timber Harvest* section above).

The procedures used to estimate tree growth and mortality depend on the remeasurement status of the annual plot in Montana. A remeasured plot refers to a plot where an inventory plot was established in the previous inventory (time 1) and the field crews were able to relocate the plot during the current inventory (time 2), and account for all trees previously measured. In the current Montana inventory (2006–2015), about 29 percent of all plots that sampled forest land in Montana were remeasured, so the same trees were measured at two points

in time. The time interval between remeasured plots in Montana varied from 4 to 12 years and averaged 10 years. On remeasurement plots—where trees were alive at time 1 and time 2—growth is calculated based on the change in volume over the time interval between plot visits. On new plots—plots established for the first time, where there was no previous co-located plot to be measured—annual growth is estimated from the previous 10 years of radial growth taken from increment cores. Mortality volume is based on the volume of any tree that qualifies as a mortality tree over the time interval between plot visits. A tree is classified as mortality if it was alive at time 1 but dead at time 2. On new plots, mortality is estimated from trees that died in the 5 years prior to the year of measurement.

In Montana, there were an estimated 877.6 MMCF of average annual gross growth for all live trees 5.0 inches diameter and greater on forest land. This is the sum of growth on all survivor and ingrowth trees. Survivor trees are live trees 5.0 inches and larger in diameter at time 1 and still alive at time 2 on remeasured plots, and live trees determined to be 5.0 inches and larger in diameter 10 years prior to the current measurement on new plots. Ingrowth trees are live trees 5.0 inches and larger in diameter that grew over the 5.0-inch threshold during the previous 10 years. In comparison, gross growth for the previous reporting period (2003–2009) was approximately 1.04 billion cubic feet per year (Menlove et al. 2012).

The average annual mortality of trees 5.0 inches and larger in diameter was 931.6 million cubic feet (tables B25–B27). Therefore, average annual net growth, calculated as gross growth minus mortality, was -54.0 million cubic feet for the 2006–2015 inventory period in Montana (tables B21–B24). The -54.0 million cubic feet of net annual growth indicates an inventory of live trees that is decreasing in the absence of trees removed from human-caused activities (i.e., removals). There was a 76 percent reduction in average annual net growth and a 25 percent increase in average annual mortality when compared to revised estimates derived from the first 6 years of data reported for Montana (Menlove et al. 2012). In comparison, neighboring Idaho, which began annual remeasurement 1 year after Montana (i.e., 2014), has remained in positive average annual net growth, whereas Wyoming estimates of average annual net growth during the annual inventory period have remained negative (fig. 9).

The decrease in average annual net growth appears large in absolute terms, but it is relatively small; average annual net growth as a percentage of net volume of all live trees 5.0 inches and larger in diameter (tables B12–B16) was close to zero (-0.13) percent for the 2006–2015 period, and has been averaging approximately 0.22 percent over the annual inventory time period (fig. 10). Idaho's average annual net growth as a percentage of total volume has also been decreasing over roughly the same period but has remained positive, averaging about 0.6 percent (fig. 10). Wyoming, by comparison, has exhibited average annual net growth as a percentage of total volume of approximately -2.0 percent (DeRose et al., 2018). Regardless of State, these data demonstrate that high mortality is offsetting gains from live-tree growth.

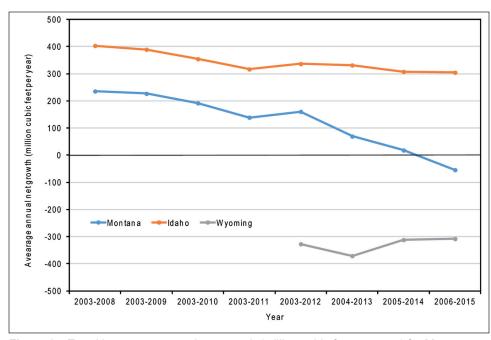


Figure 9—Trend in average annual net growth (million cubic feet per year) for Montana and adjacent States (Idaho and Wyoming) over their available evaluation periods (2003–2008 through 2006–2015).

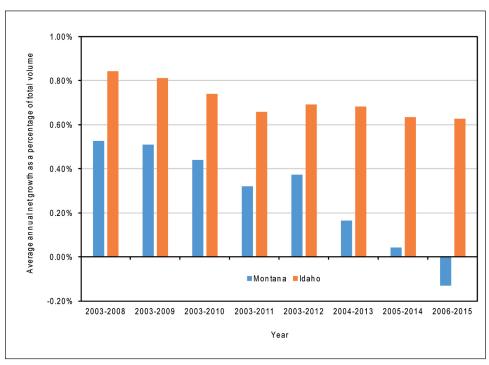


Figure 10—Average annual net growth of all live trees (greater than 5.0 inches diameter) as a percentage of total live volume (greater than 5.0 inches diameter) for the States of Montana and Idaho over evaluation periods from 2003–2008 to 2006–2015.

To further examine the effects and possible causes of high mortality levels in Montana forests, gross growth and mortality by tree species group were calculated. Average annual net growth (gross growth minus mortality) was positive for five of the seven most common (by live volume) species groups in the State (fig. 11). Lodgepole pine and the Other western softwoods species groups exhibited negative annual average net growth, -221.2 and -66.5 MMCF, respectively. Although not negative, important species groups such as Douglasfir, True fir, Engelmann and other spruces, and Ponderosa and Jeffrey pine had low ratios of gross growth to mortality and therefore relatively small margins of average annual net growth, 92.4, 24.8, 20.4, and 25.8 MMCF, respectively (fig. 11).

Thirty-three percent of the average annual mortality in Montana occurred on plots with no visible disturbance recorded at the condition level (less than 25 percent), whereas the remaining 67 percent had disturbance that affected at least 25 percent of the plot area. The leading causes of mortality across all forest types in Montana by volume affected were fire (49.7 percent of all mortality, 310.9 MMCF), insects (42.8 percent, 267.6 MMCF), and diseases (5.9 percent, 37.2 MMCF) (fig. 12). Further inquiry into mortality by forest types and disturbance types showed over two-thirds of the Lodgepole pine mortality was attributable to insects and approximately one-third to fire (fig. 13). All other forest types had more mortality volume attributable to fire than insects.

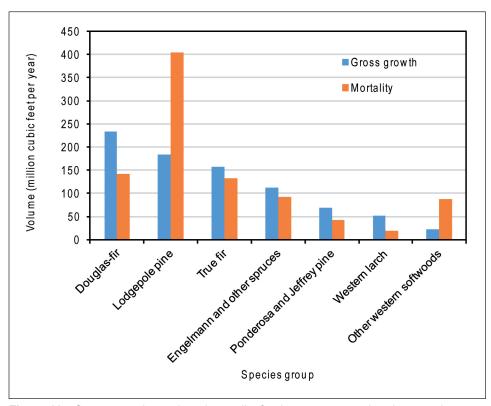


Figure 11—Gross annual growth and mortality for the seven most abundant species groups (by volume of trees greater than or equal to 5.0 inches diameter). Montana, 2006–2015. Note: average annual net growth equals gross growth minus mortality.

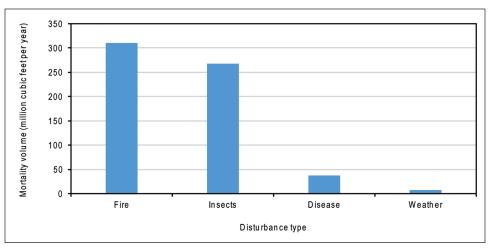


Figure 12—Average annual mortality volume (million cubic feet per year) by most common disturbance type, Montana, 2006–2015.

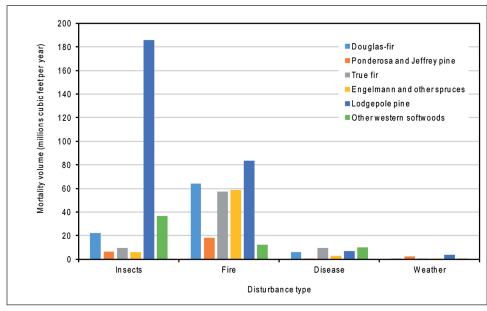


Figure 13—Average annual mortality (million cubic feet per year) by species group and predominant disturbance types, Montana, 2006–2015.

High mortality is the primary driver behind the difference between gross growth and average annual net growth in Montana. By converting the State-level estimates of mortality into per-acre estimates, one can remove the effect of differences in the amount of forest land administered by different ownership groups, and occupied by dominant forest types. Across all ownerships, the per-acre estimate of annual mortality volume averages 35.9 cubic feet per acre per year. Mortality on all National Forest lands averaged 48.9 cubic feet per acre and was on average 58.7 cubic feet per acre on National Park Service lands. State lands and private lands averaged 13.8 and 11.8 cubic feet per acre, respectively. High per-acre estimates of mortality tend to track the ownership-specific acreage in the Lodgepole pine forest type-group (table B14). While per-acre mortality in Montana was variable across forest types and owner group, only the Western

redcedar forest type had higher mortality on private landownership. In contrast, Engelmann spruce/subalpine fir, Whitebark pine, and Lodgepole pine forest types exhibited their highest per-acre mortality in the Other Federal ownership group, which includes Bureau of Land Management and the U.S. Fish and Wildlife Service (fig. 14). Mortality on the Nonstocked forest type, which has no species-derived forest type assigned to it, and the Quaking aspen forest type was highest on lands administered by the National Park Service. Ponderosa pine, Douglas-fir, Subalpine fir, and Engelmann spruce forest types had their highest level of per-acre mortality on NFS lands.

All trees classified as mortality trees are assigned a cause of death in the field. Drawing conclusions from mortality estimates by cause of death should be done with caution because the actual agent that caused a tree's death may be difficult, if not impossible, to determine. In the cases of lodgepole pine and whitebark pine, it is reasonable to assume that a large percentage of the insect-caused mortality (for example, fig. 13) was a result of recent mountain pine beetle (Dendroctonus ponderosae) activity (Hayes 2016). In the case of the Lodgepole pine and the Other western softwoods species group, where mortality exceeded gross growth, resulting in negative net growth over the 2006–2015 time period, further inquiry into mortality patterns is warranted. Among the six predominant species in Montana (by volume), lodgepole pine, and to a lesser extent whitebark pine, both exhibited significant (P < 0.01) increases in mortality over the interval beginning with the 2003–2008 evaluation period and ending with the 2007–2016 evaluation periods (fig. 15). Average annual mortality for the other species has remained relatively flat over the same period. While not directly comparable, virtually the same pattern was found in Idaho for the same group of species, over the same time period (Witt et al., 2018).

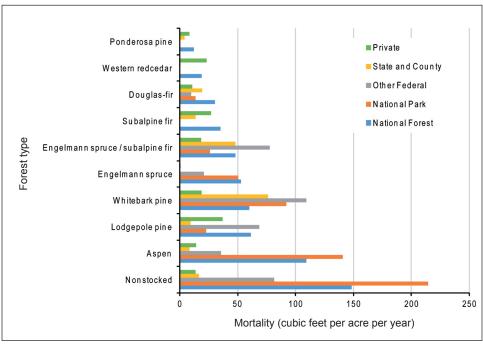


Figure 14—Mortality (cubic feet per acre per year) by important forest types and landowner groups, Montana, 2006–2015.

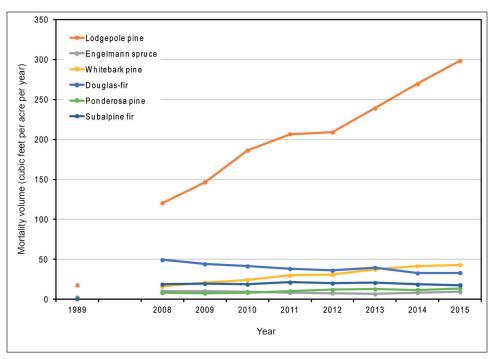


Figure 15—Average annual mortality (cubic feet per year) for the six predominant (by live volume) species in Montana over nine evaluation periods, and including an estimate from the 1989 periodic inventory.

Tree Damage and Forest Disturbance

Damage agents are recorded on live trees (≥1.0 inch d.b.h.), and can be biotic (e.g., insects, disease, animal), abiotic (e.g., fire), or human-caused (e.g., logging damage, vehicle damage). Damage is recorded when it will prevent the tree from living to maturity, surviving 10 more years if already mature, or when it will reduce the marketability of tree products. Not all trees with damages are expected to die. For example, many trees with form damages that impact merchantability are otherwise healthy and may live to typical ages for their species.

Disturbances include many of the same categories as damage agents, including insects, disease, fire, and animal- and human-caused disturbance. Instead of being recorded for individual trees they are attributed to the area sampled. Disturbances are recorded when the disturbance occurred since the last measurement (or within 5 years of first plot visit for new plots) if it has affected \geq 25 percent of trees and if the area of disturbance is \geq 1 acre.

Although damage and disturbance observations are closely related, it is possible for them to differ in the same area. For example, a fire might damage the forest where the plot is located, killing some trees and only stressing others. Insects may take advantage of the live but stressed trees in the stand, inflicting their own damage on the remaining trees. It is possible to have fire recorded as a disturbance, with individual trees damaged by fire and others damaged by insects. Up to three damage codes per live tree and three disturbances per area can be recorded, with the first being the most severe. Damage is recorded by categories and specific agents. Disturbance codes do not include specific agents

but rather are broader categories; for example, "insect damage" is recorded as a disturbance with no specific insect species noted. Only primary damage and disturbance agents are reported in this section. Geologic disturbances, including landslides and avalanches, grouped under "abiotic" here, were only recorded in 2007 and thereafter.

Sixty-nine percent of the 3.83 billion live trees in Montana showed no damage. Form damages affected 15 percent of live trees, and include damages such as broken tops or having many limbs that would result in low quality lumber. Diseases and insects affected 7 percent and 6 percent, respectively, of Montana's live trees in the 2006–2015 period (fig. 16). Disease-caused damage was relatively constant since the last reporting period but insect damage on live trees nearly doubled, from 137 million trees in 2003–2009 to 245 million in 2006–2015.

Of Montana's 25.8 million acres of forest land, disturbance was recorded on 22.1 percent (5.7 million acres) during the current reporting period (2006–2015). This is an increase of 17.4 percent since the last reporting period (2003–2009; Menlove et al. 2012), when disturbance area was estimated as 4.4 of the total 25.4 million forest land acres. Insects were responsible for the largest area of disturbance, followed by fires and disease (fig. 17). While the area disturbed by fire remained relatively constant since the last reporting period, the area of insect disturbance nearly doubled. Over 2.8 million acres are estimated to have been

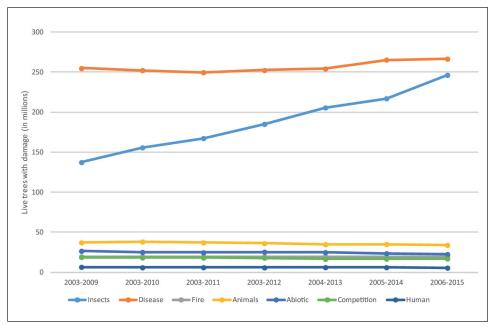


Figure 16—Damage agents on live trees (≥5 in. d.b.h.) through time. Only primary damage agent is shown and form damage is excluded. In the 2006–2015 period, disease and insects were the primary damage agent on 7 percent and 6 percent, respectively, of all live trees, and damage by insects has been increasing through time. 2.63 billion of the 3.81 billion live trees had no damage (data not shown). Form defects, which often have little effect on tree health and mortality, affected 15 percent of all live trees (data not shown). Data points on the trendline are based on inventory from all years listed in the x-axis label.

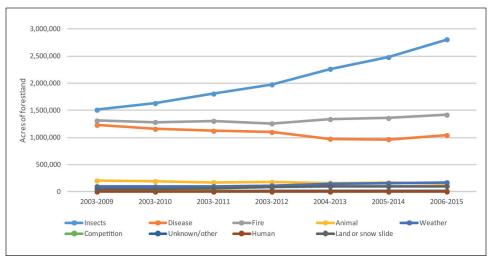


Figure 17—Acres of disturbance through time on Montana forestland. There was no disturbance recorded on 20.2 million acres in the current inventory (2006–2015), slightly less than the 21.0 million acres with no disturbance in the 2003–2009 period.

affected by insects during the current reporting period, as compared to just over 1.5 million acres estimated during the 2003-2009 period. Because insects caused the greatest amount of change over the period analyzed, insect damage and disturbance are discussed in more detail in the next section.

Native insects that attack Douglas-fir and lodgepole pine—western spruce budworm, Douglas-fir beetle, and mountain pine beetle—have been major forest health issues in Montana in the past decade. Over 125 million live Douglas-fir trees and 70 million live lodgepole pine trees had insect damage, making up 80 percent of the 245 million insect-damaged live trees in the current reporting period (table 3). Unspecified insects affected 1.29 million acres of Douglas-fir forest type and 620,000 acres of Lodgepole pine forest type (fig. 18). Annual Forest Health Protection reports also point to three insects as major issues (e.g., Hayes 2016). First, western spruce budworm (*Choristoneura freemani*) is a defoliating insect that affects Douglas-fir, along with spruce and true fir species. It results in loss of needles and growing buds, stressing but not usually killing trees (Fellin and Dewey 1982). Douglas-fir beetle (*Dendroctonus* pseudotsugae), a bark beetle that attacks Douglas-fir trees, usually exists in low density, "endemic" population levels in the absence of unusual host tree stress. Like other bark beetles, widespread stress in the host population contributes to Douglas-fir beetle outbreaks or "epidemic" conditions, causing high rates of mortality over large geographic areas where host trees are present (Furniss and Kegley 2014). Like Douglas-fir beetle, mountain pine beetle populations often exist at low levels, killing few trees. Under epidemic conditions, this native bark beetle mass attacks and quickly kills pines, primarily lodgepole pine of adequate size (McCambridge et al. 1979), but also ponderosa and whitebark pines (see Whitebark Pine Status and Trends section for more on mortality in this species).

Table 3—Number of trees (in thousands) that had a damage agent recorded, by species and agent group. Column and row totals may not sum correctly due to rounding, Montana 2006–2015.

	Percent of total number of trees affected by each damage agent group					ір				
Tree species	Total no. of trees	No damage	Insects	Diseases	Fire	Animals	Abiotic	Competition	Human	Form/ Other
Conifers										
Lodgepole pine	1,016.9	63.6	7.0	10.0	0.4	0.7	0.4	0.2	0.1	17.6
Douglas-fir	1,012.0	68.6	12.4	3.8	0.5	0.2	0.3	0.6	0.2	13.4
Subalpine fir	515.5	76.0	3.6	6.1	0.2	0.6	1.5	0.5	0.1	11.5
Engelmann spruce	304.6	79.7	4.7	4.4	0.2	0.6	0.6	0.5	0.0	9.3
Ponderosa pine	275.6	63.0	2.0	2.6	2.0	6.1	0.5	0.3	0.1	23.4
Western larch	147.5	83.6	0.3	5.8	0.8	0.5	0.3	0.4	0.4	8.0
Whitebark pine	142.1	45.3	4.5	18.7	0.2	0.6	0.5	0.2	0.0	29.9
Rocky Mountain juniper	128.4	87.7	0.0	2.2	0.3	0.1	0.2	0.2	0.6	8.7
Grand fir	49.5	79.0	3.8	5.7	0.0	0.1	1.1	1.3	0.5	8.6
Limber pine	46.4	38.5	3.1	34.4	0.0	0.9	0.6	0.1	0.3	22.1
Western redcedar	44.6	86.4	0.2	5.8	0.0	0.0	0.4	1.5	0.0	5.7
Mountain hemlock	24.4	85.8	0.3	1.2	0.0	0.0	0.9	3.7	0.0	8.0
Western hemlock	21.3	85.4	0.4	4.8	0.0	0.0	0.7	1.6	0.0	7.2
Utah juniper	6.5	82.0	0.0	2.7	2.2	0.0	9.8	0.0	0.0	3.4
Western white pine	5.2	59.7	0.7	30.2	0.0	0.0	0.0	0.7	0.0	8.6
Subalpine larch	4.3	80.7	0.0	8.7	0.0	0.0	1.7	0.0	0.0	8.9
Pacific yew	0.04	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All conifers	3744.7	69.3	6.5	6.8	0.5	0.9	0.6	0.4	0.1	14.8
Hardwoods										
Quaking aspen	31.9	52.9	0.6	30.0	0.3	3.0	0.7	0.0	0.0	12.5
Black cottonwood	10.7	50.3	0.7	17.2	0.4	1.0	0.0	0.3	0.0	30.1
Paper birch	7.0	64.2	0.0	4.8	0.0	0.0	0.5	0.0	0.0	30.5
Green ash	6.8	54.3	0.0	25.0	0.0	0.0	0.0	1.1	0.0	19.6
Plains cottonwood	5.1	31.3	0.0	11.0	0.0	1.4	0.7	0.0	0.0	55.6
Assorted hardwoods	6.5	408.7	1.0	30.5	0.0	3.9	5.5	0.0	0.0	150.4
All hardwoods	67.9	55	0.4	21.1	0.2	1.9	0.5	0.2	0.0	21.1
All Species	3,812.6	69.1	6.4	7.0	0.5	0.9	0.6	0.4	0.1	14.9

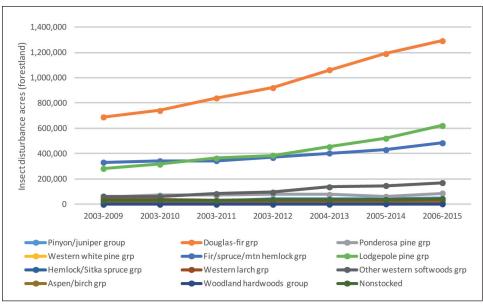


Figure 18—Acres of forestland with insect disturbance, by forest-type group, through time on forestland. The Douglas-fir and Lodgepole pine forest-type groups contain only the Douglas-fir and Lodgepole pine types, respectively.

Damage and disturbance combined with mortality information (see the Forest Growth and Mortality section) better illustrate the toll of insects on Montana's Douglas-fir forests. Defoliators including spruce budworm have affected 120.7 million trees, or 96 percent of total insect-damaged trees. Though the stress of defoliation may predispose these forests to mortality agents including Douglas-fir bark beetle, because defoliators do not usually kill trees outright, their long-term impact is likely to be minor relative to the numbers of trees affected. In contrast, bark beetles including Douglas-fir beetle were recorded on 3 percent, or 3.9 million, of live insect-damaged Douglas-fir (\geq 5.0 inches d.b.h.) in the current reporting period, but this low number belies the impact. Douglas-fir beetle attack can kill hosts quickly; only if a tree was recently attacked (needles remain green) or if an attack is unsuccessful will field crews record the tree as live with beetle damage rather than dead. Douglas-fir mortality due to insects was 64 million trees and 783 million ft³ of volume in the 2006–2015 period. This mortality has more than doubled since the 2003–2009 period, when 28 million Douglas-fir trees and 417 million ft³ of volume were killed by insects. Though forest growth and mortality information show Douglasfir retained positive net growth, the species had the second highest annual mortality rate (by volume), behind lodgepole pine, from 2008 to 2012, and the third highest mortality, behind lodgepole and whitebark pine, from 2014 to 2016 (see the Forest Growth and Mortality section).

In lodgepole pine, the connection between insect-caused damage, disturbance, and mortality is clearer because mountain pine beetle is the only major insect impacting lodgepole pine forest (Hayes 2016). Over 98 percent of all live lodgepole pine trees with insect damage had bark beetle damage in the current inventory. It is reasonable to assume a similarly high portion of the 600,000+

acres of lodgepole pine with insect disturbance were impacted by these beetles. Forest growth and mortality information shows lodgepole pine has recently had the highest annual mortality by far of any tree species in Montana (see the *Forest Growth and Mortality* section, fig. 15). Like Douglas-fir beetle, mountain pine beetle kills quickly and therefore mortality is more likely to be recorded than damage. In addition to the 6.9 million live lodgepoles with bark beetle damage, there were over 95.6 million standing insect-killed lodgepole pine trees (≥5 inches d.b.h.) in the current reporting period, making up over 1.008 billion cubic feet of volume. This was about triple the number and volume in the 2003–2009 reporting period (33.1 million trees, 345 million cubic feet). The tripling of standing insect-killed lodgepole pine and doubling in insect-disturbed lodgepole pine acres in Montana is consistent with the increasing extent and severity of mountain pine beetle outbreak in the late 2000s (Hayes 2016).

Whitebark Pine Status and Trends

Pinus albicaulis, or whitebark pine, is an iconic, high-elevation conifer that occurs throughout the northern Rocky Mountains to the Pacific Coast. It has a mutualistic relationship with the Clark's nutcracker (*Nucifraga columbiana*), which caches seeds in sites that are favorable for establishment (Hutchins and Lanner 1982), and provides food for numerous other wildlife species including red squirrels and grizzly bears. Due to recent declines caused by a combination of factors, including mountain pine beetle, changing fire regimes, white pine blister rust (*Cronartium ribicolia*), and others (Keane et al. 2012; Raffa et al. 2008), the U.S. Fish and Wildlife Service considered protecting whitebark pine under the Endangered Species Act (USFWS 2011), but did not list it due to the agency's limited budget for adding species to the protected lists. As of 2016, more than half of all standing whitebark pine trees in the Western United States were dead (Goeking and Izlar 2018).

To illuminate broad-scale status and trends in whitebark pine populations in Montana, we estimated several attributes of whitebark pine at a Statewide level and then compared them among forest types and ownership groups. Attributes we compared included forest land area with a whitebark pine component; size-class distribution of live and dead trees; mean annual growth; and mean annual mortality. Due to high recent mortality of whitebark pine, the causal agents of mortality and damage to live trees were summarized as well.

The estimates reported here were produced using the EVALIDatorPC tool, which is available from the FIA DataMart (USFS 2017). Note that standard EVALIDatorPC queries do not estimate the forest land area where an individual tree species is present. To calculate density attributes such as trees per acre, which are referred to as ratio estimates, we wrote custom queries within EVALIDatorPC to estimate the area of forest land with a whitebark pine component. Thus, the denominator in our ratio estimates consisted of the area of forest land with a whitebark pine component rather than total forest land area. We defined a "whitebark pine component" as having at least one whitebark pine tree that meets at least one of the following conditions: live and at least 1.0 inch d.b.h.; dead and at least 5.0 inch d.b.h.; or live and less than 1.0 inch d.b.h. but

at least 6.0 inches tall (i.e., a seedling). Note that differentiation of whitebark pine versus limber pine seedlings is typically done in the field by looking for nearby adult trees, which may be outside the plot footprint. The data quality control for this procedure consisted of comparing two estimates of forest land area: (1) a customized estimate of forest land area with a whitebark pine tree or seedling present within the Whitebark pine forest type, and (2) the standard EVALIDatorPC estimate of forest land area within the Whitebark pine forest type, with no filter for a whitebark pine component. The two estimates were identical.

In Montana, 671 forested plots measured between 2006 and 2015 had a whitebark pine component, the majority of which (83 percent) occurred in stands classified as a forest type other than Whitebark pine. The Whitebark pine forest type covers 612,000 acres in Montana, and forests with a whitebark pine component cover almost 4 million acres (table 4). Only 111 plots with a whitebark pine component, or 17 percent, fell in stands classified as Whitebark pine forest type. Of the remaining 560 plots, about 25 percent occurred in the Lodgepole pine forest type, another 25 percent occurred in the Engelmann spruce/subalpine fir forest type, and 19 percent occurred in the Subalpine fir forest type. The vast majority of plots with a whitebark pine component occurred on NFS lands (91 percent, or 610 plots). Other ownership groups each had 25 or fewer plots with a whitebark pine component: National Park Service (NPS) (25 plots), private (19 plots), State lands (10 plots), Bureau of Land Management (BLM) (8 plots), and other Federal lands (2 plots).

Table 4—Area (acres) represented by plots with a whitebark pine component, by forest type, Montana, 2006–2015. Percent standard errors are shown in italics in parentheses.

Forest type	Area (acres)	Standard error (%)
Douglas-fir	234,406	(15.9)
Engelmann spruce	97,493	(24.4)
Engelmann spruce/subalpine fir	1,000,574	(7.5)
Subalpine fir	736,031	(8.8)
Mountain hemlock	25,130	(49.2)
Lodgepole pine	997,213	(7.4)
Western larch	6,217	(99.5)
Limber pine	6,035	(100.6)
Whitebark pine	612,190	(9.5)
Miscellaneous western softwoods	25,397	(45.8)
Aspen	15,553	(59.7)
Nonstocked	241,155	(15.7)
Total	3,997,394	(3.4)

The number of live whitebark pine per acre, in all size classes, is greatest within the Whitebark pine forest type in Montana (fig. 19). This pattern was also observed in Idaho (Witt et al. 2018), but not in Wyoming, where the density of whitebark pine seedlings is highest in the Lodgepole pine forest type (DeRose et al. 2018). More than one-third of the 1.3 billion whitebark pine seedlings in Montana occur within the Lodgepole pine forest type, and slightly fewer occur within the Whitebark pine forest type; however, the density of seedlings is greatest in the Whitebark pine forest type. Density was calculated as the number of trees in a particular category divided by the area of forest land with a whitebark pine component in that category (e.g., the number of whitebark pines in the Lodgepole pine forest type divided by the total area of Lodgepole pine forest type with a whitebark pine component).

When we compared the total number of live and dead whitebark pines by size class (fig. 20), we found there are more live than dead whitebark pines in the smaller size classes (5.0–8.9 inches d.b.h.) and more dead than live whitebark pines in size classes above 9.0 inches. The relative amounts of live versus dead whitebark pine trees by size class, where dead trees outnumber live ones for all size classes above 9.0 inches, mirrors the trend across the entire Western United

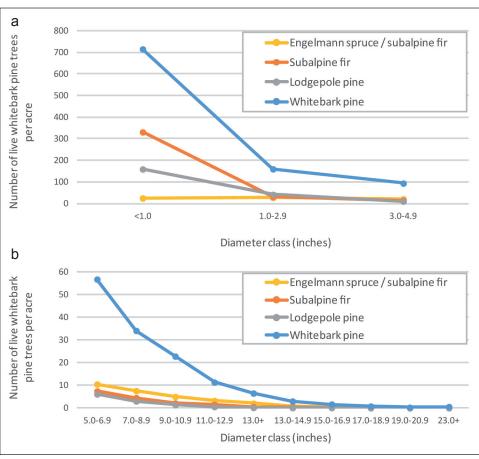


Figure 19—Mean density of live whitebark pine trees (number of trees per acre) by major forest-type (types shown in legend), as measured for trees less than 5.0 inches d.b.h. (a) and those 5.0 inches or larger (b), for Montana, 2006–2015. Only forest-types with at least 50 plots with a whitebark pine component are shown.

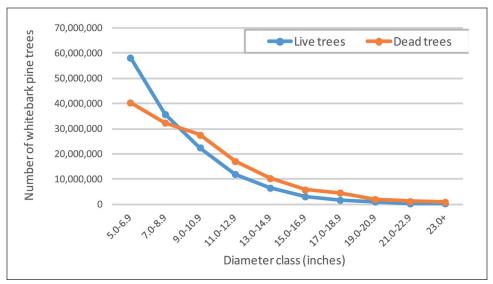


Figure 20—Total number of live and dead whitebark pine trees at least 5.0 inches d.b.h. Data are based on measurements from 671 plots Statewide, Montana, 2006–2015.

States (Goeking and Izlar 2018). There is a total of more than 142 million live whitebark pine, and nearly 143 million dead whitebark pine, that are at least 5.0 inches d.b.h. The 1.0 to 5.0 inch d.b.h. size class includes an additional 304 million live whitebark pine.

One way to assess the overall trend within a tree population is to compare rates of mean annual growth and mortality. Mean annual net growth for whitebark pine in Montana is negative among all diameter classes (fig. 21), all major ownership groups, and all major forest types with a whitebark pine component. Negative net growth indicates that mortality rates are higher than gross growth rates on a volumetric basis, and declines may continue to be observed in the coming years. Gross growth is greatest in the smallest size classes, and larger diameter classes show increasingly less growth. Mortality is highest in the 9.0–10.9-inches diameter-class, which is the smallest size class in which dead whitebark pine outnumber live (fig. 20). Whitebark pine in Montana experienced mean annual gross growth of 2.2 million cubic feet per year, compared to more than 23.8 million cubic feet per year of mortality. Thus,



Figure 21—Mean annual gross growth and mortality of trees at least 5.0 inches d.b.h., Montana, 2006–2015.

Montana's whitebark pines have experienced a net loss of almost 21.6 million cubic feet per year. This is equivalent to about 5.3 cubic feet per acre per year, given that there are nearly 4 million acres in Montana with a whitebark pine component (table 4). For comparison, Idaho's whitebark pines experienced negative mean annual net growth of about 3 cubic feet per acre per year over the same period (2006–2015; Witt et al. 2018), while Wyoming's whitebark pines lost about 24 cubic feet per acre per year between 2011 and 2015 (DeRose et al. 2018).

To examine the causes of recent mortality on FIA plots, we examined the causal agents for all whitebark pine trees that recently died (table 5). A total of 1,270 whitebark pine trees died less than 5 years prior to measurement (with the exception of plots measured in 2014–2015, which included trees that died since the previous measurement 10 years prior). Of these, 653 were determined to have been attacked by insects. Other important mortality agents were disease (319 trees) and fire (261 trees).

To illuminate the extent to which these mortality agents continue to affect live whitebark pine in Montana, we also examined damaging agents that were recorded on live trees that were not expected to survive insects, disease, or other factors (table 6). Of the 4,377 live whitebark pine that were measured on 671 plots in Montana between 2006 and 2015, 2,347 (54 percent) had no damages recorded. The most prevalent damaging agent was disease (16 percent), which was primarily rust. Other damaging agents included form defects (12 percent), dead or broken tops (9 percent), open wounds (4 percent), and insects (nearly 4 percent).

Table 5—Number of whitebark pine trees that were estimated to have died no more than 5 years prior to measurement on 671 FIA plots in Montana, 2006-2015, by causal mortality agent and forest type.

		Mortality	agent		Total by
Forest type	Insects	Disease	Fire	Other*	forest type
Douglas-fir	22	11	2	5	40
Engelmann spruce	12	0	0	0	12
Engelmann spruce/subalpine fir	154	112	1	12	279
Subalpine fir	69	42	4	2	117
Lodgepole pine	27	27	85	4	143
Limber pine	0	1	0	0	1
Whitebark pine	362	123	20	14	519
Miscellaneous western softwoods	0	2	0	0	2
Aspen	0	0	23	0	23
Nonstocked	7	1	126	0	134
Total by causal agent	653	319	261	37	1,270

^{*}Includes weather, competition/suppression, and unknown causes.

Table 6—Number of live whitebark pine trees on 671 FIA plots in Montana, 2006–2015, by damaging agent and forest type. Damaging agents that were recorded on less than 30 trees are not shown. Insects were primarily bark beetles. Disease was primarily rust. Causes of dead or broken tops were unknown. Form defects include crooks and forks in the bole.

			Dama	ging agent				Total by
Forest type	No damage	Insects	Rust and other diseases	Dead or broken top	Form defect	Open wound	Other damages	forest
Douglas-fir	41	0	13	5	3	2	0	64
Engelmann spruce	26	0	7	0	7	4	3	47
Engelmann spruce/subalpine fir	408	34	160	140	106	32	16	896
Subalpine fir	169	12	125	30	40	26	6	408
Mountain hemlock	3	0	0	0	0	0	8	11
Lodgepole pine	284	3	44	28	23	21	33	436
Whitebark pine	1,412	121	340	169	350	106	0	2,498
Miscellaneous western softwoods	1	0	2	0	0	0	3	6
Nonstocked	3	0	5	1	2	0	0	11
Total by damaging agent	2,347	170	696	373	531	191	69	4,377

Two major damaging agents that are responsible for the recent declines in whitebark pine are rust, specifically white pine blister rust, and mountain pine beetle (Keane et al. 2012; Raffa et al. 2008). The prevalence of these two agents (16 percent and 4 percent, respectively) are nearly identical to those observed in Idaho over the same time period (Witt et al. 2018). The difference between the high prevalence of disease and the low prevalence of insects on live whitebark pine suggests that rust likely has a greater impact than mountain pine beetle on the long-term viability of Montana's whitebark pine population. Furthermore, the prevalence of white pine blister rust is likely higher than the 16 percent of live whitebark pine reported here. This is because evidence of whitebark pine blister rust is not always evident until death is imminent, which means trees of any size may be infected without visible evidence of infection at the time of measurement and be dead by the subsequent remeasurement. Therefore, FIA data almost certainly underestimate the prevalence of rust. Future remeasurement of these plots and individual trees will clarify the ongoing rate and direction of trends in growth and mortality.

It is possible that whitebark pine mortality up to this point has diminished the ability of whitebark pine to produce sufficient cones for future regeneration, and future population viability may be determined more by survival of seedlings and small trees than by future regeneration (McCaughey et al. 2009). FIA will continue to collect remeasurement data and evaluate the fates of previously measured trees, which will allow us to answer questions about future survival, growth, and regeneration of whitebark pine in Montana.

Conclusions

Montana has a wide variety of forest types, structure, and species assemblages that make up almost the 25.9 million forested acres in the State. The large majority of Montana's forests (60 percent) are administered by Federal agencies such as the USDA Forest Service while most of the remaining acreage is privately owned and managed. Federal agencies manage 3.8 million acres of reserved forests in Montana and, as such, provide opportunities for non-consumptive uses such as recreation, wildlife habitat, carbon sequestration, air and water quality, view shed preservation, and traditional cultural uses. The remaining 18 million acres under Federal management are unreserved and cater to some of the same uses as reserved forest but also facilitate the development and maintenance of roads and trails, campgrounds, ski hills, and mineral and timber extraction, reflecting these agencies' multiple use mandate.

During the current inventory period, mortality of the Lodgepole pine and Other western softwoods species groups have mortality that has exceeded growth in Montana. In addition, important species groups such as Douglas-fir, True fir, Engelmann and other spruces, and Ponderosa pine groups had high ratios of gross growth to mortality. Fire appears to be the main source of tree overall tree mortality in Montana's forests (50 percent), but insects have the largest impact in lodgepole pine. Although lodgepole pine incurred the most mortality in terms of total volume and number of trees, the Douglas-fir forest type had twice as much area affected by damage and disturbance as did the Lodgepole pine forest type, and the Douglas-fir tree species had twice as much insect damage found on them than lodgepole trees.

Another particular species of interest incurring high mortality is the whitebark pine. This iconic western species has been impacted by fire, disease, and insect attack to the point that dead trees now outnumber live ones in all but the smallest size classes. These remaining small whitebark pine trees most often occur as a component of other forest types rather than as a part of whitebark pine stands, adding a confounding factor to recovery plans for this species in Montana.

The systematic interpenetrating panel design of the FIA annual inventory presents opportunities to assess trends in inventory estimates never before possible with previous periodic inventories. Therefore, the information presented in this report serves as a baseline and might indicate opportunities for further analysis, investigation, or study. Quantitative inferences about temporal trends require updated estimates each year as additional panels are remeasured. These estimators can be used to track mortality events and lead to better monitoring of forest growth and tree harvest activity. As the annual inventory effort extends into the second measurement cycle in Montana, the power to detect trends and significant effects related to growth, mortality, removals, and other parameters of interest will be realized as estimates can be derived from remeasurement of previously measured plots that will be available. In this way, the FIA program fills the need for accurate and consistent, long-term monitoring procedures and data that analysts, managers, and researchers can rely on to monitor and study forest attributes and their dynamics over time.

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Appendix A—Standard Forest Inventory and Analysis Terminology

Note: For the FIA national glossary please go to https://www.nrs.fs.fed.us/fia/data-tools/state-reports/glossary/default.asp

- **Average annual mortality**—The average annual volume of trees 5.0 inches d.b.h./d.r.c. and larger that died from natural causes.
- **Average annual net growth**—Average annual net change in volume of trees 5.0 inches d.b.h./d.r.c. and larger in the absence of cutting (average annual gross growth minus average annual mortality).
- **Basal area (BA)**—The cross-sectional area of a tree stem/bole (trunk) at the point where diameter is measured, inclusive of bark. BA is calculated for trees 1.0 inch and larger in diameter, and is expressed in square feet. For timber species, the calculation is based on diameter at breast height (d.b.h.); for woodland species, it is based on diameter at root collar (d.r.c.).
- **Biomass**—The quantity of wood fiber, for trees 1.0 inch d.b.h./d.r.c. and larger, expressed in terms of oven-dry weight. It includes above-ground portions of trees: bole/stem (trunk), bark, and branches. Biomass estimates can be computed for live and/or dead trees.
- Board-foot volume—A unit of measure indicating the amount of wood contained in an unfinished board 1.0 foot wide, 1.0 foot long, and 1.0 inch thick. Board-foot volume is computed for the sawlog portion of a sawtimber-size tree; the sawlog portion includes the part of the bole on sawtimber-size tree from a 1-foot stump to a minimum sawlog top of 7.0 inches diameter outside bark (d.o.b.) for softwoods, or 9.0 inches d.o.b. for hardwoods. Net board-foot volume is calculated as the gross board-foot volume in the sawlog portion of a sawtimber-size tree, less deductions for cull (note: board-foot cull deductions are limited to rotten/missing material and form defect—referred to as the merchantability factor—board-foot). Board-foot volume estimates are computed in both Scribner and International ½-inch rule, and can be calculated for live and/or dead (standing or down) trees.
- **Census water**—Streams, sloughs, estuaries, canals, and other moving bodies of water 200 feet wide and greater, and lakes, reservoirs, ponds, and other permanent bodies of water 4.5 acres in area and greater.
- **Coarse woody debris**—Down pieces of wood leaning more than 45 degrees from vertical with a diameter of at least 3.0 inches and a length of at least 3.0 feet.
- Condition class—The combination of discrete landscape and forest attributers that identify, define, and stratify the area associated with a plot. Such attributes include reserved status, owner group, forest type, stand-size class, stand origin, and tree density.
- **Crown class**—A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of sunlight received from above and the sides.

Crown cover (Canopy cover)—The percentage of the ground surface area covered by a vertical projection of plant crowns. Tree crown cover for a sample site includes the combined cover of timber and woodland trees 1.0 inch d.b.h./d.r.c. and larger. Maximum crown cover for a site is 100 percent; overlapping cover is not double counted.

Cubic-foot volume (merchantable)—A unit of measure indicating the amount of wood contained in a cube 1 by 1 by 1 foot. Cubic-foot volume is computed for the merchantable portion of timber and woodland species; the merchantable portion for timber species includes that part of a bole from a 1-foot stump to a minimum 4.0-inch top d.o.b., or above the place(s) of diameter measurement for any woodland tree with a single 5.0 inch stem or larger or a cumulative (calculated) d.r.c. of at least 5.0 inches to the 1.5 inch ends of all branches. **Net cubic-foot volume** is calculated as the gross cubic-foot volume in the merchantable portion of a tree, less deductions for cull.

Diameter at breast height (d.b.h.)—The diameter of a tree bole/stem (trunk) measured at breast height (4.5 feet above ground), measured outside the bark. The point of diameter measurement may vary for abnormally formed trees.

Diameter at root collar (d.r.c.)—The diameter of a tree stem(s) measured at root collar or at the point nearest the ground line (whichever is higher) that represents the basal area of the tree, measured outside the bark. For multistemmed trees, d.r.c. is calculated from an equation that incorporates the individual stem diameter measurements. The point of diameter measurement may vary for woodland trees with stems that are abnormally formed. With the exception of seedlings, woodland stems qualifying for measurement must be at least 1.0 inch in diameter or larger and at least 1.0 foot in length.

Diameter class—A grouping of tree diameters (d.b.h. or d.r.c.) into classes of a specified range. For some diameter classes, the number referenced (e.g., 4.0 inches, 6.0 inches, 8.0 inches) is designated as the midpoint of an individual class range. For example, if 2.0-inch classes are specified (the range for an individual class) and even numbers are referenced, the 6.0-inch class would include trees 5.0 to 6.9 inches in diameter.

Diameter outside bark (d.o.b.)—Tree diameter measurement inclusive of the outside perimeter of the tree bark. The d.o.b. measurement may be taken at various points on a tree (e.g., breast height, tree top) or log, and it is sometimes estimated.

Field plot/field location—A reference to the sample site or plot; an area containing the field location center and all sample points. A field location consists of four subplots and four microplots.

- **Subplot**—A 1/24-acre fixed-radius area (24-foot horizontal radius) used to sample trees 5.0 inches d.b.h./d.r.c. and larger and understory vegetation.
- **Microplot**—A 1/300-acre fixed-radius plot (6.8-foot radius), located 12 feet from the center of each subplot at an azimuth of 90 degrees, used to inventory seedlings and saplings.

- **Fixed-radius plot**—A circular sample plot of a specified horizontal radius: 1/300 acre = 6.8-foot radius (microplot); 1/24 acre = 24.0-foot radius (subplot).
- Forest land—Land that has at least 10 percent cover of live tally tree species of any size, or land formerly having such tree cover, and not currently developed for a nonforest use. The minimum area for classification as forest land is 1 acre. Roadside, stream-side, and shelterbelt strips of trees must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest if less than 120 feet in width or 1 acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied.
- **Forest type**—A classification of forest land based on the species forming a plurality of live-tree stocking.
- **Forest-type group**—A combination of forest types that share closely associated species or site requirements.
- **Gross growth**—The annual increase in volume of trees 5.0 inches d.b.h. and larger in absence of cutting and mortality. Gross growth includes survivor growth, ingrowth, growth on ingrowth, growth on removals before removal, and growth on mortality prior to death.
- **Growing-stock trees**—A live timber species, 5.0 inches d.b.h. or larger, with less than two-thirds (67 percent) of the merchantable volume cull, and containing at least one solid 8-foot section, now or prospectively, reasonably free of form defect, on the merchantable portion of the tree.
- **Growing-stock volume**—The cubic-foot volume of sound wood in growing-stock trees at least 5.0 inches d.b.h. from a 1.0-foot stump to a minimum 4.0-inch top d.o.b. to the central stem.
- Hardwood trees—Dicotyledonous trees, usually broadleaf and deciduous.
- Inventory year—The year in which a plot was scheduled to be completed.Within each subpanel, all plots have the same inventory year. Inventory year may differ from measurement year.
- **Land use**—The classification of a land condition by use or type.
- Litter—The uppermost layer of organic debris on a forest floor; that is, essentially the freshly fallen, or only slightly decomposed material, mainly foliage, but also bark fragments, twigs, flowers, fruits, and so forth. Humus is the organic layer, unrecognizable as to origin, immediately beneath the litter layer from which it is derived. Litter and humus together are often termed duff.

Logging residue/products—

- **Bolt**—A short piece of pulpwood; a short log.
- Industrial wood—All commercial roundwood products, excluding fuelwood.
- **Logging residue**—The unused sections within the merchantable portions of sound (growing-stock) trees cut or killed during logging operations.
- Mill or plant residue—Wood material from mills or other primary manufacturing plants that is not used for the mill's or plant's primary products. Mill or plant residue includes bark, slabs, edgings, trimmings, miscuts, sawdust, and shavings. Much of the mill and plant residue is used as fuel and as the raw material for such products as pulp, palletized fuel, fiberwood, mulch, and animal bedding. Mill or plant residue includes bark and the following components:
- **Coarse residue**—Wood material suitable for chipping, such as slabs, edgings, and trim.
- **Fine residue**—Wood material unsuitable for chipping, such as sawdust and shavings.
- **Pulpwood**—Roundwood, whole-tree chips, or wood residues that are used for the production of wood pulp.
- Roundwood—Logs, bolts, or other round sections cut from trees.

Mapped-plot design—A sampling technique that identifies (delineates or maps) and separately classifies distinct "conditions" on the field location sample area. Each condition must meet minimum size requirements. At the most basic level, condition class delineations include forest land, nonforest land, and water. Forest land conditions can be further subdivided into separate condition classes if there are distinct variations in reserved status, owner group, forest type, stand-size class, stand origin, and stand density, given that each distinct area meets minimum size requirements.

Measurement year—The year in which a plot was completed. Measurement year may differ from inventory year.

Merchantable portion—For trees measured at d.b.h. and 5.0 inches d.b.h. and larger, the merchantable portion (or "merchantable bole") includes the part of the tree bole from a 1.0-foot stump to a 4.0-inch top (d.o.b.). For trees measured at d.r.c., the merchantable portion includes all qualifying segments above the place(s) of diameter measurement for any tree with a single 5.0-inch stem or larger or a cumulative (calculated) d.r.c. of at least 5.0 inches to the 1.5-inch ends of all branches; sections below the place(s) of diameter measurement are not included. Qualifying segments are stems or branches that are a minimum of 1.0 foot in length and at least 1.0 inch in diameter; portions of stems or branches smaller than 1.0 inch in diameter, such as branch tips, are not included in the merchantable portion of the tree.

- **Mortality tree**—All standing or down dead trees 5.0 inches d.b.h./d.r.c. and larger that were alive at the previous inventory, or within the previous 5 years for the initial annual measurement.
- National Forest System (NFS) lands—Public lands administered by the USDA Forest Service, such as National Forests, National Grasslands, and some National Recreation Areas.
- National Park lands—Public lands administered by the Park Service, U.S. Department of the Interior, such as National Parks, National Monuments, National Historic Sites (such as National Memorials and National Battlefields), and some National Recreation Areas.
- Noncensus water—Portions of rivers, streams, sloughs, estuaries, and canals that are 30 to 200 feet wide and at least 1 acre in size; and lakes, reservoirs, and ponds 1 to 4.5 acres in size. Portions of rivers and streams not meeting the criteria for census water, but at least 30 feet wide and 1 acre in size, are considered noncensus water. Portions of braided streams not meeting the criteria for census water, but at least 30 feet in width and 1 acre in size, and more than 50 percent water at normal high-water level are also considered noncensus water.
- Nonforest land—Land that does not support, or has never supported, forests, and lands formerly forested where tree regeneration is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, power line clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.
- **Nonstocked stand**—A formerly stocked stand that currently has less than 10 percent stocking but has the potential to again become 10 percent stocked. For example, recently harvested, burned, or windthrow-damaged areas.
- Other Federal lands—Public lands administered by Federal agencies other than the USDA Forest Service or the Bureau of Land Management, U.S. Department of the Interior.
- Other public lands—Public lands administered by agencies other than the USDA Forest Service. Includes lands administered by other Federal, State, county, and local government agencies, including lands leased by these agencies for more than 50 years.
- **Poletimber-size trees**—For trees measured at d.b.h., softwoods 5.0 to 8.9 inches d.b.h. and hardwoods 5.0 to 10.9 inches d.b.h. For trees measured at d.r.c., all live trees 5.0 to 8.9 inches d.r.c.
- **Primary wood processing plants**—An industrial plant that processes roundwood products, such as sawlogs, pulpwood bolts, or veneer logs.

- **Private lands**—All lands not owned or managed by a Federal, State, or other public entity, including lands owned by corporations, trusts, or individuals, as well as Tribal lands.
- **Productive forest land**—Forest land capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land classified as a timber forest type (see Appendix C).
- Productivity—The potential yield capability of a stand calculated as a function of site index (expressed in terms of cubic-foot growth per acre per year at age of culmination of mean annual increment). Productivity values for forest land provide an indication of biological potential. Timberland stands are classified by the potential net annual growth attainable in fully stocked natural stands. For FIA reporting, Productivity Class is a variable that groups stand productivity values into categories of a specified range. Productivity is sometimes referred to as "yield" or "mean annual increment."
- **Removals**—The net volume of sound (growing-stock) trees removed from the inventory by harvesting or other cultural operations (such as timber-stand improvement), by land clearing, or by changes in land use (such as a Wilderness designation).
- **Reserved land**—Land withdrawn from management for production of wood products through statute or administrative designation; examples include Wilderness areas and National Parks and Monuments.
- **Sampling error**—A statistical term used to describe the accuracy of the inventory estimates. Expressed on a percentage basis in order to enable comparisons between the precision of different estimates, sampling errors are computed by dividing the estimate into the square root of its variance.
- **Sapling**—A live tree 1.0 to 4.9 inches d.b.h./d.r.c.
- **Sawlog portion**—The part of the bole of sawtimber-size trees between a 1.0-foot stump and the sawlog top.
- **Sawlog top**—The point on the bole of sawtimber-size trees above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches d.o.b. (diameter outside of bark) for softwoods, and 9.0 inches d.o.b. for hardwoods.
- **Sawtimber-size trees**—Softwoods 9.0 inches d.b.h. and larger and hardwoods 11.0 inches and larger.
- **Sawtimber volume**—The growing-stock volume in the sawlog portion of sawtimber-size trees in board feet.
- **Seedlings**—Live trees less than 1.0 inch d.b.h./d.r.c.
- **Site index**—A measure of forest productivity for a timberland tree/stand. Expressed in terms of the expected height (in feet) of trees on the site at an index age of 50 (or 80 years for quaking aspen and cottonwood). Calculated from height-to-age equations.

Site tree—A tree used to provide an index of site quality. Timber species selected for site index calculations must meet specified criteria with regards to age, diameter, crown class, and damage.

Snag—A standing dead tree.

Softwood trees—Coniferous trees, usually evergreen, having needle- or scale-like leaves.

Stand—A community of trees that can be distinguished from adjacent communities due to similarities and uniformity in tree and site characteristics, such as age-class distribution, species composition, spatial arrangement, structure, etc.

Stand density—A relative measure that quantifies the relationship between trees per acre, stand basal area, average stand diameter, and stocking of a forested stand.

Stand density index (SDI)—A widely used measure developed by Reineke (1933) and is an index that expresses relative stand density based on a comparison of measured stand values with some standard condition; relative stand density is the ratio, proportion, or percent of absolute stand density to a reference level defined by some standard level of competition. For FIA reporting, the SDI for a site is usually presented as a percentage of the maximum SDI for the forest type. Site SDI values are sometimes grouped into SDI classes of a specified percentage range. Maximum SDI values vary by species and region.

Standing dead tree—To qualify as a standing dead tally tree, dead trees must be at least 5.0 inches in diameter, have a bole that has an unbroken actual length of at least 4.5 feet, and lean less than 45 degrees from vertical as measured from the base of the tree to 4.5 feet. Portions of boles on dead trees that are separated greater than 50 percent (either above or below 4.5 feet) are considered severed and are included in down woody material (DWM) if they otherwise meet DWM tally criteria. For western woodland species with multiple stems, a tree is considered down if more than two-thirds of the volume is no longer attached or upright; do not consider cut and removed volume. For western woodland species with single stems to qualify as a standing dead tally tree, dead trees must be at least 5.0 inches in diameter, be at least 1.0 foot in unbroken actual length, and lean less than 45 degrees from vertical.

Stand-size class—A classification of forest land based on the predominant diameter size of live trees presently forming the plurality of live-tree stocking. Classes are defined as follows:

• Sawtimber stand (large-tree stand)—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees 5.0 inches or larger in diameter, and with sawtimber (large tree) stocking equal to or greater than poletimber (medium tree) stocking.

- Poletimber stand (medium-tree stand)—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees 5.0 inches or larger in diameter, and with poletimber (medium tree) stocking exceeding sawtimber (large tree) stocking.
- Sapling/seedling stand—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees less than 5.0 inches in diameter.
- **Nonstocked stand**—A formerly stocked stand that currently has less than 10 percent stocking but has the potential to again become 10 percent stocked. For example, recently harvested, burned, or windthrow-damaged areas.
- **Stocking**—An expression of the extent to which growing space is effectively utilized by live trees.
- **Timber species**—Tally tree species traditionally used for industrial wood products. These include all species of conifers, except pinyon and juniper. Diameters for timber species are measured at breast height (d.b.h.).
- **Timber-stand improvement**—A term comprising all intermediate cuttings or treatments, such as thinning, pruning, release cutting, girdling, weeding, or poisoning, made to improve the composition, health, and growth of the remaining trees in the stand.
- **Timberland**—Unreserved forest land capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land designated as a timber forest type (see Appendix C).
- Unproductive forest land—Forest land not capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land designated as a timber forest type and all forest lands designated as a woodland forest type (see Appendix C).
- **Unreserved forest land**—Forest land not withdrawn from management for production of wood products through statute or administrative designation.
- **Wilderness area**—An area of undeveloped land currently included in the Wilderness System, managed to preserve its natural conditions and retain its primeval character and influence.
- Woodland species—Tally tree species that are not usually converted into industrial wood products. Common uses of woodland trees are fuelwood, fenceposts, and Christmas trees. These species include pinyon, juniper, mesquite, locust, mountain-mahogany (*Cercocarpus* spp.), Rocky Mountain maple, bigtooth maple, desert ironwood, and most oaks (note: bur oak and chinkapin oak are classified as timber species). Because most woodland trees are extremely variable in form, diameter is measured at root collar (d.r.c.).

Appendix B—Standard Reporting Tables

Table B1—Percentage of plot area by land status, Montana, 2006–2015.

Land status	Percentage of sample
Accessible forest land	
Unreserved forest land	
Timberland	19.9
Unproductive	2.3
Total unreserved forest land	22.2
Reserved forest land	
Productive	3.5
Unproductive	0.3
Total reserved forest land	3.8
Total accessible forest land	26.0
Nonforest and other areas	
Nonforest land	69.7
Water	1.1
Census	0.9
Non-Census	0.2
Total nonforest and other areas	70.8
Non-response	
Access denied	2.4
Hazardous conditions	0.5
Other	0.3
Total non-response	3.2
All land	100.0

Table B2—Area of accessible forest land, in thousand acres, by owner class and forest land status, Montana, 2006–2015.

		,					
	n	Unreserved forests			Reserved forests		All forest
Owner class	Timberland	Unproductive	Total	Productive	Unproductive	Total	land
Forest Service							
National Forest	12,136.4	693.2	12,829.6	2,558.9	121.4	2,680.4	15,509.9
Other Federal							
National Park Service	;	;	;	802.7	57.1	859.9	859.9
Bureau of Land Management	841.4	404.0	1,245.4	67.3	48.1	115.4	1,360.8
Fish and Wildlife Service	!	;	!	75.1	102.6	177.7	177.7
Other Federal	10.3	5.8	16.0	1	1	:	16.0
State and local government							
State	918.9	105.9	1,024.9	4.7	;	4.7	1,029.6
Local (county, municipal, etc.)	11.8	6.5	18.4	1	:	:	18.4
Private							
Undifferentiated private	5,849.4	1,062.1	6,911.5	;	1	1	6,911.5
All owners	19,768.1	2,277.5	22,045.7	3,508.7	329.2	3,837.9	25,883.6

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B3—Area of accessible forest land, in thousand acres, by forest-type group and productivity class, Montana, 2006–2015.

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		Š	te-productivit	y class (cubic	Site-productivity class (cubic feet/acre/year)			Total all
Forest-type group	0-19	20-49	50-84	85-119	120-164	165-224	225+	classes
Pinyon / juniper group	1,351.0	;	;	;	;	;	;	1,351.0
Douglas-fir group	78.8	4,657.5	2,216.8	453.3	79.7	!	;	7,486.2
Ponderosa pine group	113.0	2,069.3	479.8	73.2	12.8	;	!	2,748.1
Western white pine group	;	6.3	1.6	;	;	3.1	;	11.0
Fir / spruce / mountain hemlock group	124.2	2,566.2	1,978.3	593.9	24.6	;	;	5,287.2
Lodgepole pine group	183.6	3,074.3	743.6	97.1	13.0	1	;	4,111.7
Hemlock / Sitka spruce group	;	24.7	108.6	63.7	18.6	;	;	215.6
Western larch group	;	179.5	516.8	159.1	56.3	12.4	6.2	930.3
Other western softwoods group	329.7	511.1	11.3	4.7	;	;	:	856.9
Oak / hickory group	10.5	8.4	;	;	;	;	!	15.2
Elm / ash / cottonwood group	52.0	126.9	36.6	37.9	;	;	;	253.4
Aspen / birch group	75.2	321.4	109.1	10.0	;	;	!	515.7
Alder / maple group	!	1	10.9	6.2	;	;	:	17.1
Woodland hardwoods group	36.7	1	;	:	!	!	;	36.7
Nonstocked	251.9	1,540.5	224.3	26.4	4.2	1		2,047.4
All forest-type groups	2,606.8	15,082.5	6,437.8	1,525.5	209.3	15.5	6.2	25,883.6

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B4—Area of accessible forest land, in thousand acres, by forest-type group, ownership group, and land status, Montana, 2006–2015.

	Forest	Forest Service	Other	Other Federal	State gove	State and local government	Undiffe	Undifferentiated private	¥
Forest-type group	Timber- land	Other forest land	Timber- land	Other forest land	Timber- Iand	Other forest land	Timber- land	Other forest land	forest land
Pinyon / juniper group	:	145.8	:	464.2	;	68.6	;	672.5	1,351.0
Douglas-fir group	3,971.9	355.6	409.9	114.6	346.8	;	2,272.2	15.1	7,486.2
Ponderosa pine group	588.5	6.3	191.1	92.3	200.1	15.5	1,583.1	71.3	2,748.1
Western white pine group	6.3	1	1	!	1.6	;	3.1	!	11.0
Fir / spruce / mountain hemlock group	3,052.8	1,322.8	41.8	424.1	64.5	;	381.2	!	5,287.2
Lodgepole pine group	2,715.9	703.6	71.5	166.1	72.3	10.8	360.1	11.5	4,111.7
Hemlock / Sitka spruce group	175.3	6.3	1	6.2	12.4	;	15.5	!	215.6
Western larch group	8.009	29.5	1.1	55.4	65.0	!	168.6	!	930.3
Other western softwoods group	312.5	428.8	5.9	37.7	6.3	1.5	16.0	48.2	856.9
Oak / hickory group	;	!	!	!	;	;	8.4	10.5	15.2
Elm / ash / cottonwood group	13.3	21.5	1.6	1.6	18.5	1.6	147.7	47.5	253.4
Aspen / birch group	108.6	58.7	1.6	42.9	21.7	;	219.8	62.6	515.7
Alder / maple group	10.9	!	1	!	6.2	;	!	!	17.1
Woodland hardwoods group	1	11.9	1	17.8	1	;	1	7.1	36.7
Nonstocked	579.7	282.7	117.2	139.8	115.5	19.2	677.1	116.0	2,047.4
All forest-type groups	12,136.4	3,373.6	851.6	1,562.6	930.8	117.1	5,849.4	1,062.1	25,883.6

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B5—Area of accessible forest land, in thousand acres, by forest-type group and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Forest-type group	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Pinyon / juniper group	896.6	309.9	144.6		1,351.0
Douglas-fir group	5,210.6	1,076.7	1,198.8		7,486.2
Ponderosa pine group	1,974.0	329.8	444.3		2,748.1
Western white pine group		3.1	7.8		11.0
Fir / spruce / mountain hemlock group	3,345.6	756.5	1,185.1		5,287.2
Lodgepole pine group	1,120.5	1,734.4	1,256.7		4,111.7
Hemlock / Sitka spruce group	190.9	18.6	6.2		215.6
Western larch group	591.3	164.6	174.5		930.3
Other western softwoods group	402.7	224.8	229.3		856.9
Oak / hickory group		15.2			15.2
Elm / ash / cottonwood group	183.2	34.5	35.8		253.4
Aspen / birch group	38.8	112.6	364.3		515.7
Alder / maple group	6.2	4.7	6.2		17.1
Woodland hardwoods group		18.7	18.0		36.7
Nonstocked	6.0		5.9	2,035.5	2,047.4
All forest-type groups	13,966.4	4,804.2	5,077.4	2,035.5	25,883.6

Table B6—Area of accessible forest land, in thousand acres, by forest-type group and stand-age class, Montana, 2006–2015.

	-uoN					Stand-	Stand-age class (years)	ears)					ΙĀ
Forest-type group	stocked	1-20	21-40	41-60	61-80	81-100	101-120	121-140	141-160	161-180	181-200	201+	classes
Pinyon / juniper group	1	93.7	153.8	228.4	272.7	243.4	150.2	72.6	67.3	20.6	37.3	11.0	1,351.0
Douglas-fir group	!	8.606	325.5	388.0	817.8	1,402.3	1,270.6	804.8	435.2	390.7	339.9	401.7	7,486.2
Ponderosa pine group	!	397.5	156.3	223.2	336.4	571.9	540.4	238.4	148.0	57.8	48.4	29.7	2,748.1
Western white pine group	!	7.8	3.1	;	;	;	!	;	;	;	;	;	11.0
Fir / spruce / mountain hemlock group	!	728.6	424.1	243.2	334.3	551.3	644.4	0.659	446.7	374.5	282.0	90.669	5,287.2
Lodgepole pine group	!	999.2	238.6	249.2	344.9	732.1	558.9	415.1	222.9	115.8	133.0	102.1	4,111.7
Hemlock / Sitka spruce group	!	6.2	;	;	29.5	63.5	36.9	39.0	23.5	4.7	1	12.3	215.6
Western larch group	!	159.0	85.4	102.7	60.1	158.3	125.5	32.4	61.7	29.5	31.7	84.0	930.3
Other western softwoods group	1	110.9	84.2	27.7	55.1	93.6	76.3	62.0	62.5	52.0	38.9	193.8	856.9
Oak / hickory group	!	1	;	9.2	;	0.9	!	;	;	;	;	;	15.2
Elm / ash / cottonwood group	1	35.8	7.7	25.6	49.6	56.2	46.9	18.1	7.7	5.9	:	!	253.4
Aspen / birch group	1	304.8	55.9	50.2	38.5	1.1	25.1	1	;	:	;	;	515.7
Alder / maple group	1	1	6.2	4.7	-	;	!	6.2	;	:	;	;	17.1
Woodland hardwoods group	1	0.9	4.5	7.5	5.9	12.9	-	1	1	1	:	!	36.7
Nonstocked	2,035.5	:	:	:	:	:	-	:	:	:	:	:	2,047.4
All forest-type groups	2,035.5	3,759.3	1,545.4	1,559.6	2,356.7	3,932.7	3,475.2	2,347.4	1,475.5	1,051.4	911.2	1,433.6	25,883.6

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B7—Area of accessible forest land, in thousand acres, by forest-type group and stand origin, Montana, 2006–2015.

	Star	nd origin	
Forest-type group	Natural stands	Artificial regeneration	All forest land
Pinyon / juniper group	1,351.0		1,351.0
Douglas-fir group	7,447.1	39.0	7,486.2
Ponderosa pine group	2,699.5	48.6	2,748.1
Western white pine group	9.4	1.6	11.0
Fir / spruce / mountain hemlock group	5,278.7	8.5	5,287.2
Lodgepole pine group	4,105.3	6.4	4,111.7
Hemlock / Sitka spruce group	215.6		215.6
Western larch group	911.5	18.9	930.3
Other western softwoods group	856.9		856.9
Oak / hickory group	15.2		15.2
Elm / ash / cottonwood group	253.4		253.4
Aspen / birch group	509.9	5.8	515.7
Alder / maple group	17.1		17.1
Woodland hardwoods group	36.7		36.7
Nonstocked	2,040.1	7.3	2,047.4
All forest-type groups	25,747.5	136.1	25,883.6

Table B8—Area of forest land. In thousand acres, by forest-type group and primary disturbance class, Montana, 2006–2015.

					Distu	Disturbance class	188					IIA
Forest-type group	None	Insects	Disease	Fire	Wild	Domestic animals	Weather Vegetation	egetation		Human	Other Human Geological	forest
Pinyon / juniper group	1,224.6	46.6	18.1	27.8	4.7	6.3	22.9	;	:	:	:	1,351.0
Douglas-fir group	5,796.2	1,286.2	253.4	105.0	;	21.4	6.2	;	;	;	17.8	7,486.2
Ponderosa pine group	2,285.6	88.3	65.0	199.5	35.1	24.0	49.5	;	;		;	2,748.1
Western white pine group	4.7	6.3	;	!	;	!	1	;	;	!	;	11.0
Fir / spruce / mountain hemlock group	4,240.9	485.4	359.5	110.7	;	;	13.3	6.2	4.1	;	0.79	5,287.2
Lodgepole pine group	3,159.7	621.9	115.2	177.6	11.2	1.6	20.6	;	;	;	4.0	4,111.7
Hemlock / Sitka spruce group	206.3	3.1	;	;	;	;	1	6.2	,	;	;	215.6
Western larch group	796.8	31.4	37.4	44.4	6.2	;	14.0	;	;	;	;	930.3
Other western softwoods group	535.7	170.8	124.3	7.9	;	!	18.2	;	;	;	;	856.9
Oak / hickory group	10.8	;	4.4	;	;	;	;	;	;	;	;	15.2
Elm / ash / cottonwood group	187.2	-	26.0	1.	0.5	8.0	14.9	;	5.8	;	;	253.4
Aspen / birch group	387.1	11.3	24.0	84.0	;	6.1	1	;	;	!	3.3	515.7
Alder / maple group	17.1	;	;	!	;	1	1	;	;	!	;	17.1
Woodland hardwoods group	32.2	4.5	!	1	!	1	1	;	!	1	;	36.7
Nonstocked	1,290.6	50.0	12.9	648.5	1.6	22.2	11.0	:	!	-	10.7	2,047.4
All forest-type groups	20,175.6	2,805.9	1,040.2	1,416.3	59.3	89.5	170.6	12.4	6.6	1.1	102.7	25,883.6

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B9—Area of timberland, in thousand acres, by forest-type group and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Forest-type group	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Douglas-fir group	4,885.5	970.6	1,144.8		7,000.8
Ponderosa pine group	1,872.9	290.4	399.4		2,562.7
Western white pine group		3.1	7.8		11.0
Fir / spruce / mountain hemlock group	2,319.8	487.2	733.3		3,540.3
Lodgepole pine group	895.6	1,387.4	936.6		3,219.7
Hemlock / Sitka spruce group	178.4	18.6	6.2		203.2
Western larch group	531.0	164.6	149.8		845.4
Other western softwoods group	206.2	63.5	71.0		340.7
Oak / hickory group		4.8			4.8
Elm / ash / cottonwood group	133.8	21.2	26.2		181.2
Aspen / birch group	38.8	69.2	243.6		351.6
Alder / maple group	6.2	4.7	6.2		17.1
Nonstocked			5.9	1,483.7	1,489.6
All forest-type groups	11,068.4	3,485.2	3,730.9	1,483.7	19,768.1

Table B10—Number of live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand trees, on forest land by species group and diameter class, Montana, 2006–2015.

and a solidary	000															Ī
	1.0-Z.9	3.0-4.9	6.9-0.9	7.0-8.9	9.01-0.8	11.0-12.9	13.0-14.9	15.0-16.9 17.0-18.9 19.0-20.9	17.0-18.9		21.0-24.9 25.0-28.9		29.0-32.9 3	33.0-36.9	37.0+	classes
Softwood species groups																
Western softwood species groups																
Douglas-fir	1,047,022	503,738	317,349	232,472	161,734	109,462	72,006	47,662	30,812	16,795	15,428	5,391	1,932	573	372	2,562,748
Ponderosa and Jeffrey pine	315,949	137,895	84,849	61,866	43,729	31,749	21,403	13,617	7,804	4,640	3,748	1,283	529	155	189	729,403
True fir	1,613,497	552,112	258,768	141,919	79,899	42,354	21,188	10,856	4,736	2,371	2,292	524	92	;	39	2,730,631
Western hemlock	34,957	12,590	7,539	4,800	2,440	2,593	1,653	1,016	487	263	258	150	;	37	37	68,819
Western white pine	9,789	3,751	1,502	1,355	716	712	339	224	112	1	112	37	113	;	;	18,762
Engelmann and other spruces	356,614	181,230	94,323	67,303	43,708	32,692	21,796	15,900	10,292	6,761	6,710	3,191	1,123	220	258	842,470
Western larch	129,742	50,874	42,582	33,641	24,086	16,578	602'6	7,542	3,787	2,844	3,481	1,756	1,055	225	187	328,091
Lodgepole pine	1,073,157	587,348	471,651	306,634	146,541	57,648	22,828	7,988	2,469	651	380	77	;	1	1	2,677,372
Western redcedar	149,538	37,161	17,909	9,491	5,713	3,695	2,760	1,756	1,049	635	899	338	74	112	150	231,283
Other western softwoods	340,933	161,028	91,037	55,825	33,298	18,029	9,397	4,371	2,377	1,379	1,139	189	112	9/	1	719,191
Other																
Western woodland softwoods	213,686	110,618	57,898	35,128	19,134	10,497	5,430	3,586	1,310	686	969	144	39	;	;	459,154
All softwoods	5,284,883 2,338,346 1,445,406	,338,346 1	,445,406	950,433	561,000	326,009	188,509	114,517	65,236	37,328	35,142	13,079	5,054	1,748	1,232 1	11,367,923
Hardwood species groups																
Western hardwood species groups																
Cottonwood and aspen	188,327	48,286	19,157	12,523	5,810	4,512	2,854	1,004	769	1,117	896	260	260	37	37	285,922
Red alder	4,190	1,862	602	38	;	38	;	;	;	!	;	;	;	;	;	6,730
Other western hardwoods	28,869	13,741	7,740	3,517	1,697	554	373	216	36	92	37	;	;	;	;	56,855
Other																
Western woodland hardwoods	9,473	8,883	2,379	877	256	71	-	42	38	-	-	;	:	;	;	22,019
All hardwoods	230,860	72,772	29,878	16,955	7,763	5,175	3,227	1,263	843	1,193	1,005	260	260	37	37	371,527
All species groups	5,515,743 2,411,118 1,475,284	411,118 1	.475,284	967,388	568,764	331,183	191,736	115,780	66.079	38,521	36,147	13,339	5,314	1,785	1,269 1	1,269 11,739,450

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Table B11—Number of growing stock trees (at least 5.0 inches d.b.h.), in thousand trees, on timberland by species group and diameter class, Montana, 2006–2015.

						Diamete	Diameter class (inches)	nes)						
Species group	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	classes
Softwood species groups														
Western softwood species groups	co.													
Douglas-fir	279,410	209,049	147,225	99,768	66,047	42,938	27,404	14,966	13,462	4,934	1,815	417	336	907,771
Ponderosa and Jeffrey pine	67,237	50,486	36,772	27,986	18,779	12,627	7,351	4,451	3,599	1,247	529	155	189	231,407
True fir	174,728	99,364	58,080	31,658	15,778	8,163	3,590	1,838	1,607	374	37	;	;	395,216
Western hemlock	7,125	4,650	2,213	2,441	1,577	827	449	225	258	150	;	37	37	19,989
Western white pine	1,465	1,317	678	009	339	224	112	;	112	37	113	;	;	4,998
Engelmann and other spruces	65,755	48,165	31,445	24,225	15,927	10,780	7,234	4,389	4,545	2,157	790	377	187	215,977
Western larch	41,018	32,377	23,195	15,462	9,001	6,759	3,451	2,733	2,996	1,532	754	225	9/	139,579
Lodgepole pine	375,801	244,745	115,616	43,276	16,202	5,576	1,720	609	264	77	;	;	;	803,887
Western redcedar	16,943	8,933	5,267	3,436	2,462	1,645	974	260	825	338	74	112	113	41,683
Other western softwoods	47,737	32,210	20,333	10,751	5,376	2,532	1,336	202	699	115	37	37	;	121,838
All softwoods	1,077,218	731,297	440,824	259,603	151,488	92,072	53,621	30,476	28,338	10,959	4,149	1,360	626	2,882,345
Hardwood species groups														
Western hardwood species groups	S													
Cottonwood and aspen	11,105	7,657	4,380	3,244	2,083	869	657	993	662	223	148	37	;	31,887
Red alder	527	38	;	38	!	;	;	;	1	;	;	;	;	602
Other western hardwoods	5,175	2,055	889	333	299	108	:	39	:	:	:	:	;	8,898
All hardwoods	16,807	9,750	5,269	3,614	2,382	806	657	1,031	662	223	148	37	1	41,387
All species groups	1.094.025	741.047	446.092	263.217	153.871	92.878	54.278	31.508	29.000	11.182	4.298	1.397	939	2.923.732

All table cells without observations in the inventory sample are indicated by - -. Table value of 0 indicates the number of trees rounds to less than 1 thousand trees. Columns and rows may not add to their totals due to rounding.

Table B12—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest land status, Montana, 2006–2015.

	Un	reserved forest	s	Re	served forests		All
Owner class	Timberland	Unproductive	Total	Productive	Unproductive	Total	forest land
Forest Service							
National Forest	25,974.7	499.9	26,474.5	4,640.5	118.7	4,759.2	31,233.7
Other Federal							
National Park Service				1,382.3	27.8	1,410.0	1,410.0
Bureau of Land Management	1,049.5	155.4	1,204.8	37.2	9.7	46.9	1,251.7
Fish and Wildlife Service				26.2	30.9	57.1	57.1
Other Federal	20.5	0.5	21.0				21.0
State and local government							
State	1,350.2	27.6	1,377.8	5.9		5.9	1,383.7
Local (county, municipal, etc.)	2.6	1.3	3.9				3.9
Private							
Undifferentiated private	5,990.7	380.7	6,371.4				6,371.4
All owners	34,388.2	1,065.3	35,453.5	6,092.1	187.0	6,279.0	41,732.6

Table B13—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Forest-type group	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Pinyon / juniper group	385.7	90.1	11.2		487.0
Douglas-fir group	11,460.8	1,297.1	387.0		13,144.9
Ponderosa pine group	2,546.4	162.9	70.9		2,780.2
Western white pine group		5.4	3.8		9.2
Fir / spruce / mountain hemlock group	10,746.2	1,380.7	408.2		12,535.1
Lodgepole pine group	3,500.8	3,812.7	287.9		7,601.4
Hemlock / Sitka spruce group	1,005.1	42.0	6.2		1,053.3
Western larch group	2,059.1	244.1	68.8		2,372.0
Other western softwoods group	734.2	207.4	44.2		985.7
Oak / hickory group		5.7			5.7
Elm / ash / cottonwood group	335.5	22.2	3.6		361.3
Aspen / birch group	95.4	94.5	57.4		247.3
Alder / maple group	11.8	2.3	9.9		24.0
Woodland hardwoods group		2.4	1.1		3.5
Nonstocked	0.3		1.7	119.9	121.9
All forest-type groups	32,881.3	7,369.6	1,361.9	119.9	41,732.6

Table B14—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Montana, 2006–2015.

		Ov	vnership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	8,463.7	814.6	501.0	2,598.8	12,378.2
Ponderosa and Jeffrey pine	1,015.5	291.2	208.5	1,641.1	3,156.4
True fir	4,549.2	327.2	109.9	308.6	5,294.8
Western hemlock	326.9	0.1	3.0	10.6	340.6
Western white pine	85.7	1.9	0.4	7.0	94.9
Engelmann and other spruces	5,060.5	475.2	85.1	331.2	5,952.0
Western larch	2,197.3	170.1	238.2	303.3	2,908.9
Lodgepole pine	7,411.1	463.3	107.5	516.6	8,498.6
Western redcedar	508.1	21.9	31.7	41.0	602.7
Other western softwoods	1,429.4	45.9	10.9	59.3	1,545.5
Other					
Western woodland softwoods	39.5	99.1	17.9	176.6	333.0
All softwoods	31,086.9	2,710.5	1,314.1	5,994.1	41,105.5
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	122.9	19.8	60.9	341.6	545.2
Red alder	1.4		0.7		2.1
Other western hardwoods	22.0	8.7	11.8	34.4	76.9
Other					
Western woodland hardwoods	0.5	0.8	0.2	1.4	2.9
All hardwoods	146.9	29.3	73.5	377.4	627.0
All species groups	31,233.7	2,739.8	1,387.6	6,371.4	41,732.6

Table B15—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and diameter class, Montana, 2006–2015.

Species group Softwood species groups														
Softwood species groups	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	9.0-10.9 11.0-12.9 13.0-14.9 15.0-16.9 17.0-18.9 19.0-20.9 21.0-24.9 25.0-28.9 29.0-32.9 33.0-36.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	ciasses
Western softwood species groups														
Douglas-fir	669	1,201	1,550	1,668	1,656	1,482	1,270	864	1,042	511	258	96	83	12,378
Ponderosa and Jeffrey pine	109	243	350	419	443	411	325	243	292	138	84	32	99	3,156
True fir	961	926	930	9//	573	414	236	150	184	74	0	1	10	5,295
Western hemlock	15	30	31	22	51	45	27	21	24	19	;	10	12	341
Western white pine	4	∞	80	15	10	10	7	-	7	7	15	;	1	92
Engelmann and other spruces	300	449	537	653	629	829	584	503	688	448	222	139	92	5,952
Western larch	108	225	315	358	307	323	211	202	342	235	190	21	4	2,909
Lodgepole pine	1,540	2,383	2,046	1,267	208	337	134	43	33	œ	1	;	1	8,499
Western redoedar	61	09	19	62	65	09	48	32	63	31	10	23	27	603
Other western softwoods	167	260	289	257	193	121	87	64	20	9	12	∞	;	1,545
Other														
Western woodland softwoods	46	22	53	48	38	35	18	16	15	2	_	:	1	333
All softwoods	4,009	5,892	6,170	5,579	4,703	3,916	2,949	2,139	2,762	1,493	801	359	333	41,106
Hardwood species groups														
Western hardwood species groups														
Cottonwood and aspen	37	22	53	69	63	26	33	09	29	29	29	œ	15	545
Red alder	~	0	1	~	1	;	1	1	;	1	:	;	;	7
Other western hardwoods	17	18	16	∞	6	4	0	က	~	1	1	;	1	77
Other														
Western woodland hardwoods	~	~	_	0	;	0	0	1	:	:	:	;	;	က
All hardwoods	99	9/	69	78	72	30	34	62	89	29	29	80	15	627
All species groups	4,065	2,968	6,239	2,657	4,776	3,947	2,982	2,201	2,830	1,522	830	367	348	41,733

All table cells without observations in the inventory sample are indicated by - -. Table value of 0 indicates the volume rounds to less than 1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B16—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand origin, Montana, 2006–2015.

	Star	nd origin	
Forest-type group	Natural stands	Artificial regeneration	All forest land
Pinyon / juniper group	487.0		487.0
Douglas-fir group	13,094.7	50.2	13,144.9
Ponderosa pine group	2,756.2	23.9	2,780.2
Western white pine group	9.2		9.2
Fir / spruce / mountain hemlock group	12,523.7	11.4	12,535.1
Lodgepole pine group	7,595.8	5.6	7,601.4
Hemlock / Sitka spruce group	1,053.3		1,053.3
Western larch group	2,351.5	20.5	2,372.0
Other western softwoods group	985.7		985.7
Oak / hickory group	5.7		5.7
Elm / ash / cottonwood group	361.3		361.3
Aspen / birch group	247.0	0.3	247.3
Alder / maple group	24.0		24.0
Woodland hardwoods group	3.5		3.5
Nonstocked	119.4	2.6	121.9
All forest-type groups	41,618.1	114.5	41,732.6

Table B17—Net volume of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, on timberland by species group and diameter class, Montana, 2006–2015.

						Diam	Diameter class (inches)	(inches)						I
Species group	5.0-6.9 7.0-8.9	7.0-8.9	9.0-10.9	11.0-12.9	.0-10.9 11.0-12.9 13.0-14.9 15.0-16.9 17.0-18.9 19.0-20.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9 25.0-28.9	25.0-28.9		29.0-32.9 33.0-36.9	37.0+	classes
Softwood species groups														
Western softwood species groups														
Douglas-fir	626	1,093	1,421	1,532	1,531	1,351	1,142	781	919	481	243	73	62	11,274
Ponderosa and Jeffrey pine	93	209	307	377	398	387	312	236	285	135	84	32	99	2,923
True fir	658	200	694	009	445	329	188	118	140	28	4	:	;	3,935
Western hemlock	4	29	27	21	48	35	25	18	24	19	:	10	12	312
Western white pine	4	∞	∞	12	10	10	7	;	Έ	7	15	:	1	91
Engelmann and other spruces	212	326	386	485	488	467	413	333	471	313	167	92	69	4,220
Western larch	105	217	303	335	287	292	193	197	290	206	137	51	48	2,631
Lodgepole pine	1,257	1,941	1,641	965	206	235	93	40	23	∞	!	;	;	6,710
Western redoedar	22	26	22	28	28	22	45	29	28	31	10	23	23	562
Other western softwoods	91	156	180	157	112	72	53	37	20	15	2	2	1	933
All softwoods	3,118 4,735	4,735	5,024	4,574	3,884	3,235	2,471	1,788	2,271	1,272	999	285	268	33,592
Can can coicean prompact														

Hardwood species groups

Western hardwood species groups

Cottonwood and aspen	25	4	43	24	23	21	29	24	47	24	21	∞	1	420
Red alder	~	0	1	~	-	1	-	-	!	;	;	;	1	7
Other western hardwoods	41	13	10	2	8	လ	:	_	:	:	-	:	-	55
All hardwoods	40	54	53	59	61	24	29	55	47	24	21	80	-	477
All species groups	3,158 4,789	4,789	5,077	4,633	3,945	3,259	2,501	1,844	2,318	1,297	687	293	268	34,068

Table B18—Net volume of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Montana, 2006–2015.

		Ov	vnership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	7,697.3	537.5	497.3	2,542.2	11,274.2
Ponderosa and Jeffrey pine	996.7	197.4	200.3	1,528.2	2,922.7
True fir	3,479.3	41.6	108.9	304.8	3,934.6
Western hemlock	298.7		3.0	10.6	312.3
Western white pine	84.1		0.4	7.0	91.5
Engelmann and other spruces	3,753.9	58.5	83.6	324.4	4,220.5
Western larch	2,083.9	10.2	237.6	299.7	2,631.5
Lodgepole pine	5,936.8	178.1	98.0	496.9	6,709.8
Western redcedar	489.7		31.6	41.0	562.2
Other western softwoods	860.3	19.2	9.9	43.2	932.7
All softwoods	25,680.7	1,042.6	1,270.5	5,598.0	33,591.9
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	86.9	5.4	59.6	268.0	419.7
Red alder	1.4		0.6		2.1
Other western hardwoods	21.0		8.8	25.0	54.8
All hardwoods	109.3	5.4	69.0	293.0	476.6
All species groups	25,790.0	1,048.0	1,339.5	5,890.9	34,068.5

Table B19—Net volume of sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by species group and diameter class, Montana, 2006–2015.

					Diam	Diameter class (inches)	nches)					7
Species group	9.0-10.9 11.0-12.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	classes
Softwood species groups												
Western softwood species groups												
Douglas-fir	5,503	7,088	7,803	7,325	905'9	4,583	5,604	3,028	1,585	494	268	50,087
Ponderosa and Jeffrey pine	089	1,479	1,979	2,203	1,927	1,511	1,955	994	673	276	626	14,304
True fir	3,523	3,258	2,516	1,911	1,124	707	896	377	23	;	;	14,336
Western hemlock	120	267	269	204	148	109	149	122	;	99	81	1,534
Western white pine	40	69	63	09	46	;	74	4	11	;	;	206
Engelmann and other spruces	2,127	2,758	2,810	2,720	2,414	1,955	2,839	2,003	1,101	604	471	21,801
Western larch	1,669	1,887	1,652	1,716	1,154	1,194	1,792	1,248	816	301	105	13,535
Lodgepole pine	9,337	5,384	2,813	1,292	502	219	125	47	1	;	-	19,719
Western redcedar	280	304	312	314	255	166	337	182	28	135	136	2,480
Other western softwoods	296	832	296	375	284	198	272	91	34	25	:	3,675
All softwoods	24,245	23,327	20,813	18,120	14,359	10,643	14,043	8,136	4,402	1,900	1,988	141,977
Hardwood species groups												
Western hardwood species groups												
Cottonwood and aspen	;	271	263	97	138	259	211	106	86	59	;	1,471
Red alder	;	ო	;	;	;	;	;	;	;	;	;	ო
Other western hardwoods	:	23	40	12	:	7	:	:	:	:	:	82
All hardwoods		297	303	109	138	266	211	106	86	29		1,557
All species groups	24,245	23,624	21,116	18,229	14,497	10,908	14,255	8,242	4,500	1,929	1,988	143,534

All table cells without observations in the inventory sample are indicated by - -. Table value of 0 indicates the volume rounds to less than 1 million board feet. Columns and rows may not add to their totals due to rounding.

Table B20—Net volume of sawlog portion of sawtimber trees, in million cubic feet, on timberland by species group and ownership group, Montana, 2006–2015.

		Oı	wnership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	5,930.3	363.6	380.9	1,793.0	8,467.8
Ponderosa and Jeffrey pine	831.9	140.3	164.1	1,168.9	2,305.2
True fir	1,968.7	21.2	70.1	173.8	2,233.8
Western hemlock	216.6		2.2	6.4	225.2
Western white pine	70.6			4.2	74.8
Engelmann and other spruces	2,960.2	36.9	62.8	229.8	3,289.6
Western larch	1,663.2	7.8	199.3	201.6	2,072.0
Lodgepole pine	2,827.8	88.5	40.0	230.9	3,187.2
Western redcedar	325.9	-	20.8	23.8	370.5
Other western softwoods	570.2	11.8	6.5	24.5	613.0
All softwoods	17,365.3	670.1	946.8	3,856.9	22,839.1
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	44.4	1.3	42.9	155.5	244.0
Red alder	0.4				0.4
Other western hardwoods	7.0		0.4	6.4	13.8
All hardwoods	51.8	1.3	43.3	161.9	258.2
All species groups	17,417.1	671.3	990.1	4,018.7	23,097.2

Table B21—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest land status, Montana, 2006–2015.

	Unre	served forests		Res	served forests		All
Owner class	Timberland	Unproductive	Total	Productive	Unproductive	Total	forest land
Forest Service							
National Forest	-31.2	-12.6	-43.8	-94.8	-1.1	-96.0	-139.8
Other Federal							
National Park Service				-21.2	1.1	-20.1	-20.1
Bureau of Land Management	-8.5	1.9	-6.6	0.3	0.2	0.5	-6.1
Fish and Wildlife Service				-0.9	0.4	-0.4	-0.4
Other Federal	0.2	0.0	0.2				0.2
State and local government							
State	16.2	0.5	16.7	0.2		0.2	16.9
Local (county, municipal, etc.)	0.1	0.0	0.1				0.1
Private							
Undifferentiated private	91.2	3.9	95.1				95.1
All owners	68.0	-6.2	61.8	-116.4	0.6	-115.8	-54.0

Table B22—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest type group and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Forest-type group	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Pinyon / juniper group	5.1	1.7	0.4		7.2
Douglas-fir group	64.6	16.5	-5.5		75.6
Ponderosa pine group	31.6	5.3	1.1		38.0
Western white pine group		0.7	-0.3		0.4
Fir / spruce / mountain hemlock group	40.4	21.4	-8.9		53.0
Lodgepole pine group	-8.9	10.6	-58.1		-56.4
Hemlock / Sitka spruce group	15.4	1.4	0.0		16.7
Western larch group	13.8	9.0	-13.9		8.8
Other western softwoods group	-10.1	-5.3	-8.4		-23.7
Oak / hickory group		0.2			0.2
Elm / ash / cottonwood group	5.0	1.1	-4.5		1.6
Aspen / birch group	2.3	2.1	-24.0		-19.6
Alder / maple group	0.6	0.1	0.5		1.2
Woodland hardwoods group		0.0	0.0		0.1
Nonstocked	0.0		0.1	-157.4	-157.3
All forest-type groups	159.8	64.9	-121.3	-157.4	-54.0

Table B23—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Montana, 2006–2015.

		Ow	nership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	34.3	1.3	8.2	48.6	92.4
Ponderosa and Jeffrey pine	2.0	0.8	3.2	19.9	25.8
True fir	20.6	-3.5	1.8	5.9	24.8
Western hemlock	8.2	-0.1	0.1	0.5	8.7
Western white pine	1.9	0.0	0.0	0.6	2.5
Engelmann and other spruces	15.8	-6.2	2.8	8.1	20.4
Western larch	25.4	-3.3	1.8	8.5	32.4
Lodgepole pine	-201.7	-11.6	-2.4	-5.5	-221.2
Western redcedar	13.2	0.1	0.5	1.2	15.0
Other western softwoods	-62.0	-3.2	-0.9	-0.3	-66.5
Other					
Western woodland softwoods	-0.1	0.7	0.3	2.0	2.9
All softwoods	-142.5	-25.0	15.3	89.5	-62.7
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	2.6	-1.5	1.0	4.3	6.4
Red alder	0.1		0.1		0.2
Other western hardwoods	0.1	0.1	0.6	1.3	2.1
Other					
Western woodland hardwoods	0.0	0.0	0.0	0.0	0.0
All hardwoods	2.7	-1.4	1.7	5.6	8.7
All species groups	-139.8	-26.4	17.0	95.1	-54.0

Table B24—Average annual net growth of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Montana, 2006–2015.

		O	wnership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	55.6	4.6	8.1	47.3	115.7
Ponderosa and Jeffrey pine	4.1	-0.2	3.0	17.5	24.3
True fir	25.9	-0.3	1.8	6.1	33.4
Western hemlock	7.5		0.1	0.5	8.1
Western white pine	1.8		0.0	0.6	2.5
Engelmann and other spruces	16.6	0.5	2.8	7.9	27.8
Western larch	26.8	0.3	1.8	8.5	37.4
Lodgepole pine	-155.4	-11.9	-2.7	-4.6	-174.6
Western redcedar	13.0		0.5	1.2	14.7
Other western softwoods	-32.0	-1.4	-0.9	-0.1	-34.5
All softwoods	-36.0	-8.4	14.4	84.8	54.8
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	2.2	0.2	1.0	3.4	6.7
Red alder	0.1		0.1		0.2
Other western hardwoods	0.1		0.5	1.0	1.6
All hardwoods	2.3	0.2	1.6	4.5	8.5
All species groups	-33.6	-8.2	15.9	89.2	63.3

Table B25—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by owner class and forest land status, Montana, 2006–2015.

	Unr	eserved forests		Re	served forests		All
Owner class	Timberland	Unproductive	Total	Productive	Unproductive	Total	forest land
Forest Service							
National Forest	555.1	22.1	577.2	178.6	2.9	181.5	758.7
Other Federal							
National Park Service				50.5	0.0	50.5	50.5
Bureau of Land Management	26.3	0.9	27.2	0.2	0.0	0.2	27.4
Fish and Wildlife Service				1.3	0.2	1.6	1.6
Other Federal	0.3		0.3				0.3
State and local government							
State	14.2	0.1	14.3				14.3
Private							
Undifferentiated private	74.7	4.1	78.8				78.8
All owners	670.5	27.3	697.8	230.6	3.2	233.8	931.6

Table B26—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Forest-type group	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Pinyon / juniper group	1.5	0.7	0.0		2.2
Douglas-fir group	129.6	24.0	21.8		175.4
Ponderosa pine group	19.5	1.9	1.7		23.1
Western white pine group			0.5		0.5
Fir / spruce / mountain hemlock group	156.7	26.5	28.2		211.4
Lodgepole pine group	66.5	93.0	74.8		234.3
Hemlock / Sitka spruce group	3.8	0.1	0.3		4.2
Western larch group	24.7	2.9	17.4		45.0
Other western softwoods group	18.9	9.9	9.8		38.7
Oak / hickory group		0.1			0.1
Elm / ash / cottonwood group	1.1	0.1	4.7		5.8
Aspen / birch group	1.0	1.1	26.3		28.4
Woodland hardwoods group		0.0			0.0
Nonstocked				162.5	162.5
All forest-type groups	423.2	160.3	185.6	162.5	931.6

Table B27—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Montana, 2006–2015.

		Ow	nership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	109.5	13.0	2.5	16.3	141.2
Ponderosa and Jeffrey pine	15.8	5.0	1.0	20.7	42.4
True fir	112.2	11.8	1.4	6.5	131.9
Western hemlock	0.0	0.1			0.2
Western white pine	0.4	0.0		0.1	0.6
Engelmann and other spruces	72.3	17.1	0.0	2.5	91.8
Western larch	10.8	5.3	1.5	1.4	19.0
Lodgepole pine	353.9	20.1	6.5	24.3	404.8
Western redcedar	0.3	0.3		0.3	0.9
Other western softwoods	81.5	4.0	1.1	1.4	88.0
Other					
Western woodland softwoods	0.8	0.7	0.1	1.0	2.5
All softwoods	757.4	77.5	14.0	74.5	923.3
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	1.0	2.1	0.3	4.2	7.5
Other western hardwoods	0.4	0.2	0.0	0.2	0.8
All hardwoods	1.3	2.3	0.3	4.4	8.3
All species groups	758.7	79.8	14.3	78.8	931.6

Table B28—Average annual mortality of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Montana, 2006–2015.

		O	wnership group		
Species group	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Western softwood species groups					
Douglas-fir	74.8	3.7	2.4	16.2	97.2
Ponderosa and Jeffrey pine	13.0	3.9	0.9	20.1	37.9
True fir	77.8	1.1	1.4	6.3	86.5
Western hemlock	0.0				0.0
Western white pine	0.4			0.1	0.5
Engelmann and other spruces	51.5	0.5	0.0	2.4	54.5
Western larch	8.6		1.5	1.4	11.5
Lodgepole pine	281.7	15.0	6.4	23.0	326.1
Western redcedar	0.3			0.3	0.6
Other western softwoods	43.9	1.8	1.0	0.8	47.5
All softwoods	552.1	26.0	13.8	70.5	662.4
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	0.8	0.1	0.3	3.2	4.4
Other western hardwoods	0.4		0.0	0.1	0.5
All hardwoods	1.2	0.1	0.3	3.3	4.9
All species groups	553.3	26.1	14.1	73.9	667.3

Table B29—Aboveground dry weight of all live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand dry short tons, by owner class and forest land status, Montana, 2006–2015.

	Uni	reserved forest	S	R	eserved forests		All
Owner class	Timberland	Unproductive	Total	Productive	Unproductive	Total	forest land
Forest Service							
National Forest	477,932	10,240	488,172	80,671	2,238	82,909	571,081
Other Federal							
National Park Service				24,068	680	24,749	24,749
Bureau of Land Management	20,754	3,104	23,858	787	228	1,014	24,872
Fish and Wildlife Service				535	686	1,221	1,221
Other federal	354	11	365				365
State and local government							
State	26,247	482	26,729	95		95	26,823
Local (county, municipal, etc.)	60	25	85				85
Private							
Undifferentiated private	118,468	7,295	125,764				125,764
All owners	643,815	21,157	664,972	106,156	3,832	109,988	774,960

All table cells without observations in the inventory sample are indicated by - -. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table B30—Aboveground dry weight of all live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand dry short tons, on forest land by species group and diameter class, Montana, 2006–2015.

							Diam	Diameter class (inches)	(inches)							IIV
Species group	1.0-2.9	1.0-2.9 3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9 13.0-14.9		15.0-16.9 17.0-18.9 19.0-20.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	21.0-22.9 23.0-24.9 25.0-26.9 27.0-28.9	27.0-28.9	29.0+	classes
Softwood species groups																
Western softwood species groups																
Douglas-fir	2,796	8,077	8,077 14,714	24,735	31,479	33,571	33,100	29,472	25,163	17,060	12,291	8,213	7,098	2,918	8,540	259,227
Ponderosa and Jeffrey pine	200	1,257	2,044	4,467	6,344	7,531	7,899	7,305	5,753	4,285	2,914	2,218	1,756	653	3,190	58,117
True fir	3,502	7,705	14,142	14,094	13,281	11,050	8,191	5,971	3,403	2,140	1,836	887	653	426	267	87,547
Western hemlock	73	197	303	248	290	1,056	970	848	516	395	390	52	;	352	419	6,738
Western white pine	4	45	92	134	129	246	165	152	114	;	51	117	103	;	236	1,571
Engelmann and other spruces	777	2,169	4,646	6,807	8,031	9,672	9,698	9,924	8,509	7,310	5,356	4,605	3,592	2,873	6,503	90,473
Western larch	425	1,007	2,283	4,638	6,405	7,205	6,137	6,433	4,181	3,997	3,376	3,348	1,975	2,627	5,514	59,550
Lodgepole pine	3,473	11,782	25,486	38,616	32,704	20,067	11,134	5,272	2,094	899	368	138	29	8	1	151,930
Western redcedar	464	604	851	816	828	831	866	790	634	423	513	304	326	83	764	9,098
Other western softwoods	292	1,738	3,219	4,913	5,415	4,778	3,572	2,244	1,607	1,180	992	513	180	148	372	31,210
Other																
Western woodland softwoods	532	936	640	802	750	684	537	202	257	246	122	108	10	26	4	6,198
All softwoods	13,121	35,516	68,392	100,600	105,956	689,96	82,270	68,915	52,230	37,705	27,983	20,503	15,760	10,200	25,819	761,659
Hardwood species groups																
Western hardwood species groups																
Cottonwood and aspen	546	864	731	1,051	925	1,163	1,042	434	542	941	202	544	135	324	784	10,531
Red alder	20	35	29	က	;	10	;	:	;	;	:	:	;	;	;	86
Other western hardwoods	138	397	474	455	380	191	212	92	4	26	:	31	;	;	1	2,433
Other																
Western woodland hardwoods	22	138	15	12	80	4	:	က	9	;	:	:	:	;	1	239
All hardwoods	759	1,433	1,249	1,521	1,313	1,368	1,254	532	225	866	202	212	135	324	784	13,301
All species groups	13,880	36,950	69,641	102,121	107,269	98,058	83,524	69,447	52,781	38,703	28,488	21,078	15,895	10,524	26,602	774,960

All table cells without observations in the inventory sample are indicated by - -. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table B31—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county and forest land status, Montana, 2006–2015.

	Unr	eserved forests		Re	served forests		All forest
Inventory unit and county	Timberland	Unproductive	Total	Productive	Unproductive	Total	land
Northwestern							
Flathead	1,689.4		1,689.4	1,086.3	23.3	1,109.6	2,799.0
Lake	519.4	17.6	537.0	12.3		12.3	549.3
Lincoln	2,138.1		2,138.1	34.0	6.2	40.2	2,178.3
Sanders	1,396.3	11.8	1,408.2	34.9	6.3	41.2	1,449.3
Total	5,743.2	29.5	5,772.7	1,167.4	35.8	1,203.2	6,975.9
Eastern							
Big Horn	368.1	51.4	419.5				419.5
Blaine	69.6	13.8	83.3	35.0	18.5	53.6	136.9
Carbon	124.4	106.9	231.3	52.6	29.5	82.1	313.5
Carter	93.8	9.5	103.3				103.3
Chouteau	55.8	5.9	61.7				61.7
Custer	118.9	49.9	168.8				168.8
Dawson		29.0	29.0				29.0
Fergus	403.4	61.3	464.8	35.4	38.8	74.2	539.0
Garfield	112.9	25.1	138.0	25.1	19.2	44.2	182.3
Glacier	119.7	72.1	191.8	185.7	23.0	208.7	400.5
Golden Valley	63.2	12.9	76.2				76.2
Hill	32.1	1.5	33.7				33.7
Liberty	1.5	6.0	7.5				7.5
McCone	2.4		2.4				2.4
Musselshell	235.3	87.9	323.2				323.2
Petroleum	52.8	72.2	124.9	12.5	6.2	18.7	143.6
Phillips	42.4	6.7	49.1	27.2	56.0	83.2	132.3
Pondera	131.0	2.9	133.9	4.3	-	4.3	138.2
Powder River	357.5	132.5	490.0				490.0
Prairie		21.6	21.6				21.6
Richland	16.3	5.9	22.2				22.2
Roosevelt	23.0	6.1	29.2				29.2
Rosebud	260.2	151.9	412.1				412.1
Stillwater	156.2	47.1	203.3	53.0	5.3	58.3	261.6
Sweet Grass	275.0	76.3	351.3	50.7	3.3	53.9	405.2
Teton	118.1	36.4	154.5	85.5	6.1	91.6	246.0
Toole	6.1		6.1				6.1
Treasure	76.4	19.1	95.4				95.4
Valley	9.4	13.4	22.9		11.9	11.9	34.8
Wibaux		15.9	15.9				15.9
Yellowstone	93.6	55.2	148.8				148.8
Total	3,418.9	1,196.4	4,615.3	566.9	218.0	784.9	5,400.2

Table B31 (continued)—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county and forest land status, Montana, 2006–2015.

	Unr	eserved forests	i	Re	served forests		All forest
Inventory unit and county	Timberland	Unproductive	Total	Productive	Unproductive	Total	land
Western							
Granite	710.2	52.7	762.9	53.4		53.4	816.3
Mineral	730.0		730.0				730.0
Missoula	1,306.9	6.3	1,313.2	98.6	1.6	100.2	1,413.4
Ravalli	953.3	24.8	978.1	210.2	3.2	213.4	1,191.5
Total	3,700.4	83.8	3,784.1	362.2	4.8	367.0	4,151.2
West Central							
Broadwater	201.0	86.3	287.3				287.3
Cascade	307.1	23.8	330.9				330.9
Jefferson	567.7	83.0	650.7				650.7
Judith Basin	235.7	66.5	302.2				302.2
Lewis and Clark	869.1	87.9	957.1	422.8	22.3	445.1	1,402.2
Meagher	600.4	59.0	659.4				659.4
Powell	693.5	37.5	731.0	249.9	10.9	260.8	991.8
Wheatland	66.4	17.0	83.4	-			83.4
Total	3,540.9	461.0	4,002.0	672.7	33.2	705.9	4,707.9
Southwestern							
Beaverhead	1,136.5	138.6	1,275.1	17.6		17.6	1,292.7
Deer Lodge	205.6	42.8	248.4	29.7	6.3	36.0	284.3
Gallatin	723.0	66.5	789.6	93.7	6.5	100.2	889.8
Madison	647.7	147.8	795.6	101.2	6.4	107.6	903.2
Park	415.5	97.6	513.0	497.3	18.3	515.6	1,028.7
Silver Bow	236.4	13.5	249.9				249.9
Total	3,364.7	506.8	3,871.5	739.5	37.5	777.0	4,648.5
All counties	19,768.1	2,277.5	22,045.7	3,508.7	329.2	3,837.9	25,883.6

(continued on next page)

	Forest	Forest Service	Other Federal	ederal	State and lo	State and local government	Undifferentiated private	ed private	ΑI
Inventory unit and county	Timberland	Other forest land	Timberland	Other forest land	Timberland	Other forest land	Timberland for	Other forest land	forest land
Northwestern									
Flathead	1,141.5	606.2	;	503.4	132.3	;	415.6	;	2,799.0
Lake	150.5	18.4	1	;	42.1	5.7	326.9	5.8	549.3
Lincoln	1,694.4	40.2	1	;	55.9	1	387.8	;	2,178.3
Sanders	872.8	41.9	!	5.6	62.8	!	460.7	5.6	1,449.3
Total	3,859.1	7.907	:	508.9	293.2	5.7	1,590.9	11.3	6,975.9
Eastern									
Big Horn	!	;	7.4	;	22.6	1.6	338.1	49.8	419.5
Blaine	1	;	12.2	62.8	4.6	1	52.7	4.6	136.9
Carbon	88.7	81.6	12.4	78.0	6.2	1	17.2	29.5	313.5
Carter	65.8	;	1	;	!	1	28.0	9.5	103.3
Chouteau	16.1	;	10.2	;	1.5	1	28.0	5.9	61.7
Custer	1	;	15.6	10.9	9.4	1	93.9	39.0	168.8
Dawson	1	!	1	11.0	!	4.5	!	13.5	29.0
Fergus	81.4	6.2	87.8	0.76	12.4	1	221.8	32.4	539.0
Garfield	!	!	59.9	62.7	5.9	0.8	47.2	5.9	182.3
Glacier	27.5	;	1	208.7	1	1	92.2	72.1	400.5
Golden Valley	17.2	!	5.7	;	!	!	40.2	12.9	76.2
Ī	1	;	:	!	7.5	1	30.6	1 5	33.7
Liberty	1	!	1.5	0.9	!	1	!	;	7.5
McCone	1	1	!	;	0.5	!	1.9	;	2.4
Musselshell	1	!	20.5	;	!	9.7	214.8	78.2	323.2
Petroleum	1	!	46.5	70.0	6.2	8.4	!	12.5	143.6
Phillips	1	!	12.1	83.9	!	3.0	30.3	3.0	132.3
Pondera	116.6	4.3	1	;	!	1	14.4	2.9	138.2
Powder River	225.6	46.7	18.2	49.1	10.6	1	103.1	36.6	490.0
Prairie	1	1	1	21.6	:	1	:	;	21.6
Richland	1	:	-	;	11.9	1.5	4.4	4.4	22.2

Table B32 (continued)—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county, ownership group and forest land status, Montana, 2006–2015.

	Forest	Forest Service	Other Federal	ederal	State and loo	State and local government	Undifferentiated private	ated private	Ā
Inventory unit and county	Timberland	Other forest land	Other Timberland forest land	Other forest land	Timberland	Other forest land	Timberland	Other forest land	forest land
Eastern (continued)									
Roosevelt	1	1	!!	4.6	!	!	23.0	1.5	29.2
Rosebud	44.7	26.4	6.4	29.4	18.0	19.6	192.6	76.5	412.1
Stillwater	48.2	2'. 29	5.3	;	5.3	!	97.3	37.8	261.6
Sweet Grass	171.0	68.0	8.0	1.6	3.6	!	92.3	9.09	405.2
Teton	93.5	102.2	13.1	10.6	1	7.6	11.4	7.5	246.0
Toole	1	;	6.1	;	!	:	1	;	6.1
Treasure	;	1	0.1	;	1.4	;	72.1	19.1	95.4
Valley	1	;	;	23.9	!	:	9.4	1.5	34.8
Wibaux	1	1	1	4.7	!	;	1	11.2	15.9
Yellowstone	1	1	6.5	12.8	2.8	7.2	84.3	35.2	148.8
Total	996.2	403.1	354.2	849.2	127.1	63.9	1,941.4	665.0	5,400.2
Western									
Granite	506.5	93.9	21.1	6.4	25.9	!	156.7	7.3	816.3
Mineral	657.7	1	!!	;	37.0	!	35.3	1	730.0
Missoula	604.2	105.0	19.3	;	173.4	!	510.0	1.5	1,413.4
Ravalli	824.3	225.8	1	;	35.2	;	93.7	12.4	1,191.5
Total	2,592.7	424.7	40.4	4.9	271.5		7.967	21.2	4,151.2
West Central									
Broadwater	142.4	25.2	12.9	18.7	!	!	45.7	42.5	287.3
Cascade	163.9	15.4	26.1	;	13.9	6.9	103.2	1.5	330.9
Jefferson	387.8	39.0	53.0	13.5	5.8	7.0	121.1	23.4	650.7
Judith Basin	217.1	6.73	1	;	1	5.8	18.6	2.8	302.2
Lewis and Clark	467.4	516.6	66.3	1.5	36.3	!	299.1	14.9	1,402.2
Meagher	411.7	30.2	0.9	;	12.2	:	170.5	28.8	659.4
Powell	366.6	285.7	79.1	;	51.5	1	196.3	12.5	991.8
Wheatland	37.1	12.4	1	1	7.7	-	21.6	4.6	83.4
Total	2,194.0	982.3	243.4	33.8	127.4	19.8	976.1	131.1	4,707.9

Table B32 (continued)—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county, ownership group and forest land status, Montana, 2006–2015.

	Forest	Forest Service	Other Federal	ederal	State and lo	State and local government	Undifferentiated private	ated private	Ι
Inventory unit and county	Other Timberland forest land	Other forest land	Timberland	Other Timberland forest land	Timberland	Other forest land	Other Timberland forest land	Other forest land	forest land
Southwestern									
Beaverhead	0.996	126.3	100.7	16.4	28.1	3.0	41.7	10.5	1,292.7
Deer Lodge	140.4	62.6	6.3	;	36.3	4.7	22.6	11.5	284.3
Gallatin	534.9	58.6	;	56.3	15.6	4.4	172.6	47.5	889.8
Madison	449.9	136.2	80.8	23.5	6.4	0.9	110.6	89.7	903.2
Park	267.6	470.2	;	8.69	13.7	9.7	134.1	63.6	1,028.7
Silver Bow	135.4	2.9	25.9	;	11.5	:	63.6	10.6	249.9
Total	2,494.3	856.8	213.6	165.9	111.5	27.7	545.2	233.4	4,648.5
All counties	12,136.4	3,373.6	851.6	1,562.6	930.8	117.1	5,849.4	1,062.1	25,883.6

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B33—Area of timberland, in thousand acres, by Forest Survey Unit, county and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Inventory unit and county	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Northwestern					
Flathead	920.1	263.7	420.2	85.3	1,689.4
Lake	328.4	81.9	96.9	12.2	519.4
Lincoln	1,277.7	382.0	431.8	46.6	2,138.1
Sanders	871.0	153.7	299.0	72.6	1,396.3
Total	3,397.2	881.4	1,247.9	216.7	5,743.2
Eastern					
Big Horn	164.7	53.6	59.5	90.1	368.1
Blaine	25.4	25.2	6.5	12.4	69.6
Carbon	72.4	17.0	35.0		124.4
Carter	50.5	3.0	17.7	22.5	93.8
Chouteau	26.3	11.9	10.2	7.3	55.8
Custer	58.1	9.4	12.4	39.0	118.9
Fergus	287.7	47.0	48.9	19.8	403.4
Garfield	23.9	22.1	16.2	50.7	112.9
Glacier	30.3	20.6	48.2	20.6	119.7
Golden Valley	51.7		11.5		63.2
Hill	19.9	6.1	4.6	1.5	32.1
Liberty			1.5		1.5
McCone	0.5			1.9	2.4
Musselshell	109.1	32.1	36.7	57.4	235.3
Petroleum	22.1	7.3		23.4	52.8
Phillips	15.6	12.1	8.6	6.1	42.4
Pondera	61.2	15.8	54.0		131.0
Powder River	188.9	35.9	46.4	86.3	357.5
Richland	10.4	5.9			16.3
Roosevelt	16.9		6.1		23.0
Rosebud	154.0	29.1	14.7	62.4	260.2
Stillwater	95.5	12.3	11.8	36.6	156.2
Sweet Grass	139.4	30.1	35.2	70.3	275.0
Teton	30.5	43.7	34.7	9.1	118.1
Toole	6.1				6.1
Treasure	48.2	0.1	7.0	21.1	76.4
Valley	9.4				9.4
Yellowstone	36.3	11.4	19.2	26.7	93.6
Total	1,755.0	452.0	546.6	665.3	3,418.9

Table B33 (continued)—Area of timberland, in thousand acres, by Forest Survey Unit, county and stand-size class, Montana, 2006–2015.

		Stand-size	class		All size
Inventory unit and county	Large diameter	Medium diameter	Small diameter	Nonstocked	classes
Western					
Granite	372.7	134.3	147.9	55.3	710.2
Mineral	516.9	70.0	112.3	30.8	730.0
Missoula	692.2	162.1	345.0	107.6	1,306.9
Ravalli	544.0	141.2	188.7	79.3	953.3
Total	2,125.8	507.6	793.9	273.0	3,700.4
West Central					
Broadwater	97.8	56.1	31.3	15.8	201.0
Cascade	167.1	82.3	49.0	8.7	307.1
Jefferson	321.5	158.8	82.4	5.0	567.7
Judith Basin	109.8	78.9	45.8	1.3	235.7
Lewis and Clark	470.6	168.2	175.6	54.9	869.1
Meagher	316.9	161.2	115.1	7.3	600.4
Powell	335.7	193.6	124.9	39.3	693.5
Wheatland	44.8	9.3	12.4		66.4
Total	1,864.1	908.3	636.3	132.2	3,540.9
Southwestern					
Beaverhead	550.8	399.4	121.2	65.1	1,136.5
Deer Lodge	58.3	46.9	89.4	10.9	205.6
Gallatin	447.7	93.5	132.7	49.1	723.0
Madison	451.4	90.0	83.0	23.4	647.7
Park	282.3	49.5	40.1	43.5	415.5
Silver Bow	135.8	56.5	39.7	4.4	236.4
Total	1,926.3	735.9	506.1	196.5	3,364.7
All counties	11,068.4	3,485.2	3,730.9	1,483.7	19,768.1

Table B34—Area of timberland, in thousand acres, by Forest Survey Unit, county and stocking class, Montana, 2006–2015.

		Stoc	Stocking class of growing-stock trees	ck trees		
Inventory unit and county	Nonstocked	Poorly stocked	Moderately stocked	Fully stocked	Overstocked	All classes
Northwestern						
Flathead	88.3	379.2	664.4	505.9	51.6	1,689.4
Lake	12.4	146.4	252.5	102.0	6.1	519.4
Lincoln	46.6	490.5	860.9	679.8	60.3	2,138.1
Sanders	78.9	419.0	578.0	273.2	47.3	1,396.3
Total	226.2	1,435.0	2,355.8	1,560.8	165.4	5,743.2
Eastern						
Big Horn	91.7	121.2	101.5	48.9	4.8	368.1
Blaine	12.4	47.4	6.5	3.3	1	9.69
Carbon	4.4	33.0	35.2	51.8	:	124.4
Carter	22.5	48.8	16.5	0.9	!	93.8
Chouteau	7.3	17.8	29.3	1.5	1	55.8
Custer	48.3	28.0	42.1	;	0.5	118.9
Fergus	21.2	131.9	125.1	123.6	1.5	403.4
Garfield	50.7	50.4	7.4	4.4	;	112.9
Glacier	22.3	21.7	26.1	38.3	11.3	119.7
Golden Valley	:	11.5	31.4	20.3	1	63.2
壹	1.5	10.7	13.8	6.1	1	32.1
Liberty	;	!	;	1.5	!	1.5
McCone	2.4	!	!	:	!	2.4
Musselshell	2.69	109.1	45.0	6.8	4.6	235.3
Petroleum	23.4	27.6	8.1	;	1	52.8
Phillips	6.1	20.7	10.6	5.0	1	42.4
Pondera	!	21.6	37.4	64.0	7.9	131.0
Powder River	107.5	191.0	36.3	22.7	;	357.5
Richland	:	;	4.4	5.9	5.9	16.3

 Table B34 (continued)
 Area of timberland, in thousand acres, by Forest Survey Unit, county and stocking class, Montana, 2006–2015.

Eastern (continued) Rosevelt Rosebud Stillwater Sweet Grass Teton Toole	Nonstocked	Poorly stocked	Moderately stocked	Fully stocked	Overstocked	
Eastern (continued) Roosevelt Rosebud Stillwater Sweet Grass Teton Toole				in the second se		S S S S S S S S S S S S S S S S S S S
Roosevelt Rosebud Stillwater Sweet Grass Teton Toole						
Rosebud Stillwater Sweet Grass Teton Toole	!	:	10.7	12.3	;	23.0
Stillwater Sweet Grass Teton Toole	62.4	119.8	54.9	23.2	;	260.2
Sweet Grass Teton Toole	36.6	57.3	38.6	23.6	;	156.2
Teton Toole	70.3	53.6	63.2	77.8	10.0	275.0
Toole	9.1	33.5	19.8	54.1	7.	118.1
	;	6.1	;	;	;	6.1
Treasure	28.1	20.6	27.6	;	0.1	76.4
Valley	;	;	9.4	;	;	9.4
Yellowstone	33.2	48.9	4.9	6.5	;	93.6
Total 7	731.2	1,232.2	799.6	2.709	48.2	3,418.9
Western						
Granite	55.8	201.7	232.9	196.7	23.0	710.2
Mineral	30.8	159.9	320.0	191.0	28.3	730.0
Missoula 1	107.6	488.6	475.2	214.6	20.9	1,306.9
Ravalli	80.2	304.0	377.4	178.9	12.8	953.3
Total 2	274.4	1,154.2	1,405.6	781.2	85.0	3,700.4
West Central						
Broadwater	15.8	54.7	65.8	57.5	7.2	201.0
Cascade	8.7	81.2	128.8	81.5	6.9	307.1
Jefferson	6.5	161.0	276.6	123.5	0.1	2.795
Judith Basin	1.3	37.2	93.5	87.5	16.2	235.7
Lewis and Clark	6.53	328.0	287.2	156.7	41.3	869.1
Meagher	7.3	161.7	250.3	172.1	9.1	600.4
Powell	45.5	244.1	198.4	180.6	25.0	693.5
Wheatland		4.6	30.9	18.5	12.4	66.4
Total	141.1	1,072.6	1,331.3	877.9	118.0	3,540.9

Table B34 (continued)—Area of timberland, in thousand acres, by Forest Survey Unit, county and stocking class, Montana, 2006–2015.

		Stock	Stocking class of growing-stock trees	k trees		
Inventory unit and county	Nonstocked	Poorly stocked	Moderately stocked	Fully stocked	Overstocked	All classes
Southwestern						
Beaverhead	65.1	235.4	469.5	327.0	39.5	1,136.5
Deer Lodge	10.9	37.5	71.2	79.7	6.3	205.6
Gallatin	49.1	169.8	354.4	143.2	6.5	723.0
Madison	36.8	191.5	239.9	158.8	20.7	647.7
Park	43.5	110.5	174.8	77.0	9.6	415.5
Silver Bow	7.1	100.4	80.9	45.0	2.9	236.4
Total	212.6	845.2	1,390.7	830.7	85.5	3,364.7
All counties	1,585.4	5,739.1	7,283.1	4,658.4	502.1	19,768.1

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B35—Net volume of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

				-						
			Growing stock	Z.				Sawtimber		
		Major sp	Major species group				Major sp	Major species group		
Inventory unit and county	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	AII species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	AII species
			(In million cubic feet)	feet)			l)	(In million board feet)	feet)	
Northwestern										
Flathead	469.0	2,832.3	35.1	48.0	3,384.4	1,469.0	13,236.0	42.7	183.8	14,931.6
Lake	160.0	960.1	2.8	1.0	1,123.8	704.7	4,370.3	3.0	;	5,078.0
Lincoln	8368	4,375.0	37.4	14.6	5,326.8	3,421.1	20,682.1	152.2	58.3	24,313.7
Sanders	586.0	2,274.9	7.8	1.0	2,869.7	2,683.2	10,715.5	31.6	5.5	13,435.8
Total	2,114.9	10,442.2	83.0	64.6	12,704.7	8,278.1	49,003.8	229.5	247.6	57,759.1
Eastern										
Big Horn	219.0	58.2	1.6	2.1	280.9	752.0	216.4	8.2	1.6	978.2
Blaine	25.7	2.0	2.7	;	33.3	49.8	23.0	1.5	1	74.4
Carbon	101.5	81.4	4.1	1.5	188.5	352.6	383.3	6.1	7.7	749.8
Carter	66.4	;	;	9.0	0.79	282.2	;	;	1	282.2
Chouteau	22.4	29.6	2.8	1	54.8	78.1	121.2	2.6	1	202.0
Custer	59.3	;	1.9	;	61.2	215.9	;	7.1	1	223.0
Fergus	316.3	233.2	21.7	;	571.2	1,219.4	835.2	31.8	1	2,086.4
Garfield	23.5	;	7.4	1	30.9	63.5	;	32.6	1	0.96
Glacier	32.9	92.5	6.4	5.1	136.8	156.8	458.5	4.7	18.4	638.4
Golden Valley	34.9	31.6	;	1	66.4	8.98	108.9	;	1	195.7
Ī	29.1	37.3	0.3	1	2.99	82.9	187.0	;	1	269.9
Musselshell	110.9	;	0.0	1	110.9	339.3	!	;	1	339.3
Petroleum	17.6	;	;	1	17.6	36.3	:	;	1	36.3
Phillips	41.5	0.1	;	1	41.5	130.8	:	;	1	130.8
Pondera	53.1	143.2	1.0	9.0	197.9	251.8	559.3	;	1	811.1
Powder River	190.0	;	2.5	4.0	192.9	768.7	:	3.7	0.7	773.1
Richland	-	-	43.1	4.9	48.0	:	-	166.7	10.5	177.2
									(continued on next page)	n next page)

Table B35 (continued)—Net volume of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

			Growing stock	×				Sawtimber		
		Major spe	Major species group				Major sp	Major species group		
Inventory unit and county	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	AII species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	AII species
		i)	(In million cubic feet)	feet)			l)	(In million board feet)	feet)	
Eastern (continued)										
Roosevelt	!	;	23.3	4.0	27.3	;	;	77.8	;	77.8
Rosebud	170.7	;	8.0	0.5	172.0	735.3	;	;	;	735.3
Stillwater	73.7	38.4	1.2	7.1	120.4	263.4	145.5	6.0	36.4	446.2
Sweet Grass	103.8	215.1	;	;	318.9	324.0	807.9	;	;	1,131.9
Teton	34.3	134.3	4.6	2.5	175.7	122.9	521.2	17.0	11.0	672.0
Toole	7.	4.5	0.1	;	5.7	;	16.9	;	;	16.9
Treasure	47.0	;	1.2	;	48.3	207.2	;	;	;	207.2
Valley	;	;	14.6	9.0	15.2	;	;	71.8		71.8
Yellowstone	23.7	;	;	;	23.7	70.6	;	;	;	9.07
Total	1,798.4	1,104.3	141.2	29.8	3,073.7	6,590.3	4,384.3	432.5	86.3	11,493.4
Western										
Granite	589.5	681.5	8.0	;	1,271.8	1,713.8	2,947.7	4.3	;	4,665.8
Mineral	292.3	1,583.9	;	5.1	1,881.2	1,399.3	7,465.0	;	26.6	8,890.9
Missoula	452.0	1,593.1	13.8	13.7	2,072.6	2,000.4	7,368.5	38.6	62.8	9,470.3
Ravalli	709.5	962.5	0.4	9.5	1,682.0	3,296.3	4,385.0	;	39.8	7,721.1
Total	2,043.3	4,821.0	15.0	28.3	6,907.6	8,409.8	22,166.2	43.0	129.2	30,748.1
West Central										
Broadwater	75.6	229.7	;	;	305.3	172.8	947.1	;	!	1,119.9
Cascade	223.8	220.1	5.0	;	449.0	711.6	875.0	23.5	!	1,610.1
Jefferson	320.1	505.3	5.1	;	830.5	692.8	2,143.9	14.1	;	2,850.9
Judith Basin	129.0	272.9	;	;	401.8	387.1	8.926	;	!	1,343.9
Lewis and Clark	322.3	2.685	21.4	11.5	944.9	1,147.0	2,331.8	62.3	45.8	3,586.9
Meagher	402.5	518.3	3.2	;	924.0	1,233.7	2,070.3	;	;	3,304.0
Powell	331.7	798.1	9.7	;	1,139.5	1,230.7	3,437.0	21.6	:	4,689.4
Wheatland	35.4	61.3	28.8	-	125.5	118.2	258.6	117.6		494.4
Total	1,840.5	3,195.3	73.1	11.5	5,120.5	5,694.0	13,020.6	239.1	45.8	18,999.4

Table B35 (continued)—Net volume of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

			Growing stock	ock				Sawtimber		
		Major sp	secies group				Major sp	Major species group		
Inventory unit and county	Pine	Other softwoods	Soft hardwoods	Soft Hard hardwoods hardwoods	AII species	Pine	Other softwoods	Other Soft Hard softwoods hardwoods	Hard hardwoods	AII species
			(In million cubic feet)	(teet)			l)	(In million board feet)	feet)	
Southwestern										
Beaverhead	1,337.3	956.0	9.9	!	2,299.9	3,931.6	4,056.6	25.9	1	8,014.1
Deer Lodge	172.3	9.79	1.3	!	241.1	446.9	261.0	;	!	707.9
Gallatin	442.4	1,046.4	8.1	0.2	1,497.2	1,490.5	5,134.6	35.9	!	6,660.9
Madison	375.1	807.9	3.4	!	1,186.3	1,410.1	3,525.2	2.0	!	4,937.4
Park	187.0	515.5	8.4	!	710.9	649.5	2,331.6	32.3	!	3,013.3
Silver Bow	116.1	208.6	1.9	!	326.5	283.7	0.606	7.6	1	1,200.3
Total	2,630.1	3,601.9	29.7	0.2	6,261.9	8,212.3	16,218.0	103.7	:	24,534.1
All counties	10,427.0	10,427.0 23,164.9	342.1	134.4	34,068.5	37,184.5	104,792.9	1,047.8	508.8	143,534.1

All table cells without observations in the inventory sample are indicated by -. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

Table B36—Average annual net growth of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

			Growing stock	<u> </u>				Sawtimber		
		Major s	Major species group				Major	Major species group		
Inventory unit and county	Pine	Other	Soft	Hard	All	Pin	Other	Soft	Hardwoods	All
				(+00+)				oiding adilliam al)	(, ()	
N out the state of			(III IIIIIIIIIII cabic leet)	leer)				(iii iiiiiioii cubic leet)	(leer)	
Flathead	α	7 7 7	7	7	36.2	7	170 5	,	O œ	201 5
	1 c	7 7 	- 0	- C	5 5	- 6	10.07	- 0	ò	22 - 22
Lake	7.3	9. 8.	0.0	0.7	7.1.7	4.22	107.4	1.0	1	129.9
Lincoln	18.6	9.62	-0.1	0.5	98.7	125.8	445.4	6:0-	1.2	571.4
Sanders	-4.3	35.0	0.2	0.0	30.9	12.5	227.0	0.7	0.0	240.2
Total	23.9	159.0	1.8	2.4	187.0	201.9	950.2	6.0	10.1	1,163.1
Eastern										
Big Horn	3.6	1.5	-0.1	0.1	2.0	19.7	5.1	9.0-	9.0	24.8
Blaine	0.8	0.1	0.1	!	6.0	3.8	9.0	0.0	!	4.5
Carbon	-2.3	-0.7	0.0	-0.2	-3.1	-8.0	-3.2	0.1	<u></u>	-12.2
Carter	-0.2	1	1	0.0	-0.2	2.3	;	1	!	2.3
Chouteau	-2.4	0.7	0.0	:	-1.7	-12.5	2.8	0.3	;	-9.5
Custer	0.9	1	0.0	!	6.0	4.4	;	0.3	!	4.7
Fergus	1.9	4.8	-0.5	!	6.2	20.4	23.3	-1.8	!	41.9
Garfield	-0.6	-0.2	0.1	!	-0.7	0.3	-0.7	0.5	!	0.1
Glacier	-1.7	0.1	0.1	0.1	4.1-	2.1	4.5	0.1	0.3	6.9
Golden Valley	0.2	0.3	1	!	0.5	3.7	1.7	1	!	5.4
H	<u>-</u> .	9.0	0.0	!	-0.5	-5.8	5.0	1	!	-0.8
Musselshell	2.2	1	0.0	!	2.2	10.8	;	1	!	10.8
Petroleum	-0.5	1	1	!	-0.5	-1.2	;	1	!	-1.2
Phillips	7.	0.0	1	!	1.7	3.4	;	1	!	3.4
Pondera	-1.0	-0.1	0.0	0.1	-1.0	-5.6	4.2	1	;	4. 1-
Powder River	1.3	1	0.1	0.0	4.	9.3	;	0.1	0.7	10.1
Richland	1	1	0.7	0.1	8.0	!	;	7.7	0.2	7.9
									(continuec	(continued on next page)

Table B36 (continued)—Average annual net growth of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

			Growing stock	ck				Sawtimber		
		Major spe	species group				Major	Major species group		
Inventory unit and county	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species
			(In million cubic feet)	feet)				(In million cubic feet)	feet)	
Eastern (continued)										
Roosevelt	;	;	0.3	0.3	0.5	;	;	6.0	!	6.0
Rosebud	4.3	;	0.0	0.0	4.4	20.7	;	!	!	20.7
Stillwater	-0.2	9.0	0.0	0.2	9.0	3.7	3.2	0.0	6.0	7.8
Sweet Grass	-6.2	-3.7	:	;	6.6-	-32.6	-9.1	1	1	-41.7
Teton	-0.4	1.	0.1	0.1	0.8	-1.5	2.4	0.3	0.8	2.0
Toole	0.0	0.1	0.0	!	0.1	;	0.3	1	1	0.3
Treasure	0.1	;	0.1	!	0.2	1.2	;	1	1	1.2
Valley	1	;	0.3	0.0	0.3	;	;	1.3	!	1.3
Yellowstone	-0.3	;	:	;	-0.3	0.2	;	1	1	0.2
Total	-0.8	5.2	1.5	9.0	6.5	38.8	40.0	9.3	2.3	90.4
Western										
Granite	-9.9	-10.4	0.0	!	-20.3	-3.8	-34.1	0.1	1	-37.8
Mineral	-9.3	26.0	!	0.2	17.0	-18.2	176.0	1	3.6	161.4
Missoula	-2.1	25.2	0.0	9.0	23.7	16.7	156.2	4.1	2.1	179.1
Ravalli	-3.6	-4.0	-0.1	0.1	9.7-	47.2	-1.5	0.0	3.3	49.1
Total	-24.9	36.8	0.0	6.0	12.8	41.9	296.6	4.2	9.0	351.8
West Central										
Broadwater	-8.1	0.5	1	1	-7.6	-16.6	8.7	!	!	-7.9
Cascade	-0.7	2.4	0.1	1	4.8	<u></u>	14.2	0.7	!	13.8
Jefferson	-39.4	6.2	0.2	!	-33.0	-133.9	36.1	2.8	1	-95.1
Judith Basin	-0.5	4.	!	1	6.0	6.0-	4.5	1	1	3.6
Lewis and Clark	-28.8	1.2	0.5	0.3	-26.9	-82.7	20.3	9.6	0.0	-51.8
Meagher	-20.2	6.5	0.1	1	-13.5	-61.2	27.5	!	!	-33.7
Powell	-15.7	9.1	0.0	;	-6.6	-55.8	61.1	3.7	1	9.1
Wheatland	0.3	0.8	-0.1	:	1.0	3.3	5.6	-0.4	1	8.5
Total	-113.1	28.1	6.0	0.3	-83.9	-348.8	178.0	16.4	0.0	-153.6

Table B36 (continued)—Average annual net growth of growing stock trees (at least 5.0 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by Forest Survey Unit, county, and major species group, Montana, 2006–2015.

			Growing stock	ck				Sawtimber		
		Major s	species group				Major	Major species group		
Inventory unit and county		Other Pine softwoods	Soft hardwoods	Hard hardwoods	AII species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All
			(In million cubic feet)	feet)				(In million cubic feet)	feet)	
Southwestern										
Beaverhead	-14.9	-3.4	0.0	!	-18.3	-11.2	1.	0.5	1	9.6-
Deer Lodge	6.9-	1.7	0.0	1	-5.2	-29.9	9.3	1	!	-20.7
Gallatin	-4.7	9.8	0.0	0.0	4.0	7.5	54.9	0.1	!	62.6
Madison	-24.4	2.6	0.1	1	-21.7	-101.3	25.2	0.0	1	-76.1
Park	-9.5	0.1	0.1	1	-9.3	-47.5	7.0	0.0	1	-40.6
Silver Bow	-11.0	2.5	-0.1	!	-8.6	-39.0	15.7	0.1	1	-23.2
Total	-71.4	12.0	0.2	0.0	-59.1	-221.5	113.2	0.7		-107.6
All counties	-186.3	241.1	4.3	4.2	63.3	-287.8	1,578.0	31.5	22.3	1,344.1

All table cells without observations in the inventory sample are indicated by - -. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

(continued on next page)

Table B37—Sampling errors by Forest Survey Unit and county for area of timberland, volume, average annual net growth, average annual removals, and average annual montality on timberland, Montana, 2006–2015.

	Forest	Timberland	Gro	wing stock	Growing stock (on timberland)	(þt	ις (awtimber (c	Sawtimber (on timberland)	
Inventory unit and county	area	area	Volume	Growth	Removals	Mortality	Volume	Growth	Removals	Mortality
Northwestern										
Flathead	1.35	3.95	6.55	31.75	;	19.84	7.60	26.81	;	22.56
Lake	3.11	3.76	9.52	14.68	;	22.10	11.27	14.60	;	26.64
Lincoln	1.16	1.38	4.61	7.88	;	14.69	5.56	7.58	;	18.66
Sanders	1.74	1.99	6.38	26.82	;	17.53	7.22	15.78	;	17.58
Total	0.78	1.40	3.09	8.80	:	9.98	3.63	7.29	-	11.53
Eastern										
Big Horn	8.86	9.71	17.71	26.77	;	36.65	18.73	21.84	;	42.19
Blaine	16.5	25.07	34.61	39.73	;	71.64	38.06	32.59	;	88.30
Carbon	8.42	16.92	24.10	81.51	;	38.00	27.64	95.87	;	41.30
Carter	22.37	23.19	38.03	100.00	;	43.54	40.30	100.00	;	49.75
Chouteau	28.56	29.84	36.94	100.00	;	72.31	43.56	100.00	;	74.83
Custer	13.58	17.72	26.28	44.40	;	43.69	31.06	36.36	;	46.44
Dawson	42.62	1	;	;	;	;	;	;	;	1
Fergus	6.79	7.74	10.32	20.78	;	24.47	11.92	15.48	;	27.32
Garfield	16.24	20.93	33.55	100.00	;	60.63	40.48	100.00	;	63.88
Glacier	7.50	19.50	40.27	100.00	;	49.51	45.15	100.00	;	60.05
Golden Valley	25.52	28.97	36.11	63.66	;	69.23	40.18	45.76	;	78.81
Ē	40.83	42.54	48.25	100.00	;	76.85	50.01	100.00	;	82.69
Liberty	82.34	100.00	;	;	;	;	;	;	;	1
McCone	81.21	81.21	;	;	;	;	;	;	;	1
Musselshell	9.40	12.24	17.73	31.41	;	56.29	21.35	24.53	;	51.28
Petroleum	18.25	30.93	41.39	100.00	;	76.19	46.97	100.00	;	83.61
Phillips	19.13	35.49	44.36	42.01	;	100.00	54.67	44.97	:	100.00
Pondera	8.41	7.98	21.44	100.00	;	33.22	26.40	100.00	;	33.87
Powder River	6.81	8.88	18.47	100.00	;	46.65	22.01	84.91	;	49.46
Prairie	49.95	1	;	;	;	;	;	;	;	1
Richland	47.25	95.75	76.79	67.15	:	88.12	86.48	77.03	:	:

Table B37 (continued)—Sampling errors by Forest Survey Unit and county for area of timberland, volume, average annual net growth, average annual removals, and average annual mortality on timberland, Montana, 2006–2015.

	Forest	Timberland	Gro	wing stock	Growing stock (on timberland)	(þt	Ø	awtimber (o	Sawtimber (on timberland)	
Inventory unit and county	area	area	Volume	Growth	Removals	Mortality	Volume	Growth	Removals	Mortality
Eastern (continued)										
Roosevelt	42.69	50.03	59.79	64.72	;	;	65.48	68.98	;	;
Rosebud	8.24	11.23	19.67	16.81	;	60.48	23.00	19.76	;	99.93
Stillwater	10.30	16.65	24.26	100.00	;	47.32	25.99	79.25	;	57.75
Sweet Grass	6.72	10.00	18.19	70.78	;	42.12	21.15	85.38	;	47.59
Teton	7.60	17.61	33.44	100.00	;	54.09	43.28	100.00	;	61.08
Toole	100.00	100.00	100.00	100.00	;	;	100.00	100.00	;	;
Treasure	22.38	25.99	36.88	100.00	;	76.85	40.57	100.00	;	72.78
Valley	39.62	73.07	70.80	70.65	;	;	71.51	71.07	;	;
Wibaux	57.63	:	!	;	;	:	;	;	;	1
Yellowstone	17.39	23.17	35.84	100.00	;	74.36	43.59	100.00	;	86.39
Total	2.35	3.22	5.54	100.00		14.84	6.63	49.67		18.18
Western										
Granite	2.20	4.12	10.14	47.83	;	22.05	12.97	100.00	;	24.66
Mineral	2.22	2.22	7.57	41.00	;	23.97	8.97	22.25	;	27.70
Missoula	1.71	2.54	7.23	20.85	;	17.48	8.32	13.49	;	18.94
Ravalli	2.13	4.03	7.89	100.00	;	20.45	9.28	80.43	;	21.96
Total	1.03	1.64	4.02	100.00	:	10.96	4.75	21.43	-	12.25
West Central										
Broadwater	7.62	10.17	18.68	62.66	;	35.57	23.42	100.00	;	36.14
Cascade	7.27	8.31	13.96	100.00	;	36.18	19.42	100.00	;	50.73
Jefferson	3.91	4.95	8.89	23.05	;	15.72	11.22	34.19	;	16.92
Judith Basin	3.88	7.77	14.41	100.00	;	34.01	18.78	100.00	;	39.47
Lewis and Clark	2.10	5.83	9.94	40.47	;	23.61	11.25	79.03	;	24.38
Meagher	4.05	4.79	8.69	39.73	;	16.21	10.90	70.50	;	16.74
Powell	2.28	5.70	10.63	84.38	;	18.56	12.61	100.00	;	21.52
Wheatland	25.36	29.19	39.53	47.61	:	45.77	43.40	43.80		49.63
Total	1.41	2.45	4.30	19.61	;	8.93	5.32	44.86	-	9.43
										1

Table B37 (continued)—Sampling errors by Forest Survey Unit and county for area of timberland, volume, average annual net growth, average annual removals, and average annual mortality on timberland, Montana, 2006–2015.

	Forest	Timberland	Gro	wing stock	Growing stock (on timberland)	(p)	Ϊ́	awtimber (o	Sawtimber (on timberland)	
Inventory unit and county	area		Volume	Growth	Removals Mortality	Mortality	Volume	Growth	Removals Mortality	Mortality
Southwestern										
Beaverhead	2.77	3.54	6.22	58.29	;	18.30	7.54	100.00	;	19.74
Deer Lodge	5.45	11.09	20.24	85.48	;	38.81	23.93	100.00	;	43.20
Gallatin	3.18	4.43	8.56	100.00	;	19.40	10.16	36.81	;	21.79
Madison	3.83	5.92	9.54	33.01	;	18.38	11.15	49.55	;	20.21
Park	3.27	9.83	12.97	57.95	;	26.74	13.80	98.76	;	27.92
Silver Bow	6.55	6.29	12.96	52.46	;	31.56	16.45	77.86	;	33.60
Total	1.51	2.40	3.99	26.84	:	9.62	4.77	74.72	-	10.44
All counties	0.67	96.0	1.79	52.61	;	4.66	2.15	12.02	:	5.18

All table cells without observations in the inventory sample are indicated by - -. Sampling errors that exceed 100% are reported as 100%.

Appendix C—Montana Forest-Type Groups and Forest Types, with Descriptions and Timber (T) or Woodland (W) Designation

Forest types are usually named for the predominant species (or group of species) on the condition. In order to determine the forest type, the stocking (site occupancy) of trees is estimated by softwoods and hardwoods. If softwoods predominate, then the forest type will be one of the softwood types and if hardwoods predominate, then the forest type will be one of the hardwood types. Some other special stocking rules apply to individual forest types, and are described below.

Associate species are defined as those that regularly form the majority of the non-predominant species stocking of mixed-species conditions. These descriptions are applicable to the current inventory; species importance, including predominance in some cases, will vary for other States or inventory years. When species are listed, they are in decreasing order of overall forest type stocking.

ALDER/MAPLE GROUP (T)

Red alder

Predominant species: red alder Associate species: none identified

Other species: Engelmann spruce, paper birch, Douglas-fir, subalpine fir, grand

fir, western redcedar

ASPEN/BIRCH GROUP (T)

Quaking Aspen

Predominant species: quaking aspen

Associate species: lodgepole pine, Douglas-fir, black cottonwood, Rocky Mountain juniper, limber pine

Other species: Engelmann spruce, water birch, paper birch, ponderosa pine, western larch, grand fir, subalpine fir, whitebark pine, western white pine

Paper birch

Predominant species: paper birch

Associate species: Douglas-fir, lodgepole pine

Other species: black cottonwood, Engelmann spruce, western larch, grand fir, quaking aspen, western redcedar

DOUGLAS-FIR GROUP (T)

Douglas-fir

Predominant species: Douglas-fir

Associate species: lodgepole pine, ponderosa pine, western larch, Engelmann spruce, subalpine fir, limber pine, Rocky Mountain juniper, grand fir

Other species: quaking aspen, western redcedar, black cottonwood, whitebark pine, paper birch, western hemlock, western white pine, mountain hemlock, curlleaf mountain-mahogany, Pacific yew, red alder

ELM/ASH/COTTONWOOD GROUP (T)

Cottonwood

Predominant species: plains cottonwood, black cottonwood, narrowleaf cottonwood

Associate species: quaking aspen, lodgepole pine

Other species: Douglas-fir, Engelmann spruce, western larch, paper birch, green ash, ponderosa pine, water birch, subalpine fir, boxelder, limber pine, grand fir

Special rules: Stocking of cottonwoods must be at least 50 percent of total stocking.

Cottonwood/willow

Predominant species: black cottonwood

Associate species: paper birch

Other species: Douglas-fir, Engelmann spruce, western larch, grand fir, subalpine

fir

Special rules: Stocking of cottonwoods is less than 50 percent, but predominant. In order to meet 50 percent hardwood stocking, other hardwoods must be present.

Sugarberry/hackberry/elm/green ash

Predominant species: green ash, boxelder

Associate species: none identified Other species: Plains cottonwood

Special rules: Several species, mostly Eastern, are evaluated for this type.

Those species found in Montana are American elm, green ash, and boxelder.

Depending on species mix, stands with some of these same predominant species may be classified as Elm/ash/black locust.

FIR/SPRUCE/MOUNTAIN HEMLOCK GROUP (T)

Blue spruce

Predominant species: blue spruce Associate species: none identified

Other species: no other species encountered

Engelmann spruce

Predominant species: Engelmann spruce

Associate species: Douglas-fir, lodgepole pine, subalpine fir, western larch, quaking aspen, whitebark pine

Other species: black cottonwood, western redcedar, limber pine, paper birch, western white pine, grand fir, western hemlock, ponderosa pine, Pacific yew, water birch, Rocky Mountain juniper

Special rules: In order to use Engelmann spruce stocking predominance, subalpine fir stocking must be less than 5 percent of the total. Or, if subalpine fir stocking is 5 percent or more, Engelmann spruce stocking must be at least 75 percent of the total.

FIR/SPRUCE/MOUNTAIN HEMLOCK GROUP (T) (continued)

Engelmann spruce/subalpine fir

Predominant species: subalpine fir, Engelmann spruce

Associate species: lodgepole pine, Douglas-fir, whitebark pine, western larch, limber pine

Other species: western hemlock, grand fir, western redcedar, subalpine larch, quaking aspen, mountain hemlock, black cottonwood, western white pine, paper birch, Pacific yew, ponderosa pine, Rocky Mountain juniper

Special rules: The combined stocking of Engelmann spruce with subalpine fir is predominant. Stocking of both Engelmann spruce and subalpine fir must each be between 5 and 74 percent of the total.

Grand fir

Predominant species: grand fir

Associate species: Douglas-fir, western larch, western redcedar, Engelmann spruce, lodgepole pine, subalpine fir, western hemlock, western white pine

Other species: paper birch, quaking aspen, ponderosa pine, black cottonwood, water birch, Pacific yew, mountain hemlock, Rocky Mountain juniper

Mountain hemlock

Predominant species: mountain hemlock

Associate species: subalpine fir, Engelmann spruce

Other species: lodgepole pine, Douglas-fir, subalpine larch, western larch, whitebark pine, grand fir

Subalpine fir

Predominant species: subalpine fir

Associate species: lodgepole pine, Douglas-fir, Engelmann spruce, whitebark pine, western larch

Other species: limber pine, mountain hemlock, western redcedar, grand fir, subalpine larch, western hemlock, quaking aspen, ponderosa pine, Pacific yew, black cottonwood, water birch, western white pine

Special rules: In order to use subalpine fir stocking predominance, Engelmann spruce stocking must be less than 5 percent of the total. Or, if Engelmann spruce stocking is 5 percent or more, subalpine fir stocking must be at least 75 percent of the total.

HEMLOCK/SITKA SPRUCE GROUP (T)

Western hemlock

Predominant species: western hemlock

Associate species: Engelmann spruce, western redcedar, western larch, grand fir, Douglas-fir, subalpine fir, western white pine

Other species: quaking aspen, paper birch, lodgepole pine

Western redcedar

Predominant species: western redcedar

Associate species: Douglas-fir, western larch, grand fir, western hemlock, Engelmann spruce, lodgepole pine, subalpine fir

Other species: black cottonwood, paper birch, quaking aspen, western white pine, ponderosa pine, Pacific yew

LODGEPOLE PINE GROUP (T)

Lodgepole pine

Predominant species: lodgepole pine

Associate species: Douglas-fir, subalpine fir, Engelmann spruce, western larch, whitebark pine

Other species: quaking aspen, paper birch, grand fir, limber pine, western redcedar, ponderosa pine, western white pine, black cottonwood, mountain hemlock, western hemlock, Rocky Mountain juniper, subalpine larch

NONSTOCKED

Nonstocked

Predominant species: various, most commonly ponderosa pine, but many nonstocked conditions have no live-tree stocking.

Associate species: various

Other species: seldom more than two or three species on a condition. Complete species list: ponderosa pine, Douglas-fir, lodgepole pine, Rocky Mountain juniper, subalpine fir, limber pine, Engelmann spruce, whitebark pine, western larch, green ash, narrowleaf cottonwood, subalpine larch, curlleaf mountain-mahogany, black cottonwood, quaking aspen, grand fir

Special rules: Used when all live stocking is less than ten percent. Implies disturbance, but may be used for sparse stands with no disturbance, especially on poor sites.

OAK/HICKORY GROUP (T)

Elm/ash/black locust

Predominant species: green ash, American elm

Associate species: none identified

Other species: no other species encountered

Special rules: Several species, mostly Eastern, are evaluated for this type. Those found in Montana are American elm and green ash. Depending on species mix, stands with some of these same predominant species may be classified as Sugarberry/hackberry/elm/green ash.

OTHER WESTERN SOFTWOODS GROUP (T)

Limber pine

Predominant species: limber pine

Associate species: Douglas-fir, ponderosa pine, Engelmann spruce, Rocky Mountain juniper

Other species: quaking aspen, subalpine fir, lodgepole pine, Utah juniper

Miscellaneous western softwoods

Predominant species: subalpine larch, Pacific yew

Associate species: subalpine fir, Douglas-fir, Engelmann spruce, whitebark pine Other species: lodgepole pine, western white pine, grand fir, western larch, mountain hemlock

Special rules: A "catch-all" group, especially for softwood species with a limited geographical range.

OTHER WESTERN SOFTWOODS GROUP (T) (continued)

Whitebark pine

Predominant species: whitebark pine

Associate species: subalpine fir, Engelmann spruce, lodgepole pine, Douglas-fir

Other species: subalpine larch, quaking aspen, limber pine

PINYON/JUNIPER GROUP (W)

Juniper woodland

Predominant species: Utah juniper Associate species: none identified

Other species: curlleaf mountain-mahogany, Douglas-fir, Rocky Mountain

juniper, limber pine

Special rules: Predominance of any combination of junipers other than Rocky

Mountain juniper, and live pinyons are NOT present.

Rocky Mountain juniper

Predominant species: Rocky Mountain juniper

Associate species: ponderosa pine, Douglas-fir, limber pine

Other species: curlleaf mountain-mahogany, Utah juniper, black cottonwood, plains cottonwood, lodgepole pine, green ash, quaking aspen, water birch

PONDEROSA PINE GROUP (T)

Ponderosa pine

Predominant species: ponderosa pine

Associate species: Douglas-fir, Rocky Mountain juniper, western larch

Other species: quaking aspen, lodgepole pine, limber pine, green ash, black cottonwood, paper birch, Engelmann spruce, grand fir, western redcedar,

plains cottonwood, subalpine fir

WESTERN LARCH GROUP (T)

Western larch

Predominant species: western larch

Associate species: Douglas-fir, lodgepole pine, Engelmann spruce, subalpine fir,

grand fir

Other species: western redcedar, ponderosa pine, paper birch, western white pine, black cottonwood, western hemlock, quaking aspen, mountain hemlock, whitebark pine, Pacific yew

WESTERN WHITE PINE GROUP (T)

Western white pine

Predominant species: western white pine

Associate species: Douglas-fir

Other species: lodgepole pine, black cottonwood, mountain hemlock, western

redcedar, grand fir, western hemlock, western larch, subalpine fir

WOODLAND HARDWOODS GROUP (W)

Cercocarpus (mountain brush) woodland

Predominant species: curlleaf mountain-mahogany

Associate species: Rocky Mountain juniper, Douglas-fir

Other species: limber pine

Special rules: curlleaf mountain-mahogany is the only species evaluated for

this type.

Appendix D—Tree Species Groups and Tree Species Measured in Montana's Annual Inventory, with Common Name, Scientific Name, and Timber (T) or Woodland (W) Designation

HARDWOODS Cottonwood and aspen group (T)

Black cottonwood (Populus balsamifera ssp. trichocarpa)

Narrowleaf cottonwood (Populus angustifolia)

Plains cottonwood (Populus deltoides ssp. monilifera)

Quaking aspen (*Populus tremuloides*)

Other western hardwoods group (T)

American elm (*Ulmus Americana*)

Boxelder (Acer negundo)

Paper birch (Betula papyrifera)

Water birch (Betula occidentalis)

Red alder group (T)

Red alder (Alnus rubra)

Woodland hardwoods group (W)

Curlleaf mountain-mahogany (Cercocarpus ledifolius)

SOFTWOODS Douglas-fir group (T)

Douglas-fir (Pseudotsuga menziesii)

Engelmann and other spruces group (T)

Blue spruce (*Picea pungens*)

Engelmann spruce (Picea engelmannii)

Lodgepole pine group (T)

Lodgepole pine (Pinus contorta)

Other western softwoods group (T)

Limber pine (*Pinus flexilis*)

Mountain hemlock (Tsuga mertensiana)

Pacific yew (Taxus brevifolia)

Subalpine larch (*Larix lyallii*)

Whitebark pine (*Pinus albicaulis*)

Ponderosa group (T)

Ponderosa pine (Pinus ponderosa)

True fir group (T)

Grand fir (*Abies grandis*)

Subalpine fir (*Abies lasiocarpa*)

Western hemlock group (T)

Western hemlock (Tsuga heterophylla)

Western larch group (T)

Western larch (*Larix occidentalis*)

Western redcedar group (T)

Western redcedar (*Thuja plicata*)

Western white pine group (T)

Western white pine (Pinus monticola)

Woodland softwoods group (W)

Rocky Mountain juniper (*Juniperus scopulorum*)

Utah juniper (*Juniperus osteosperma*)

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